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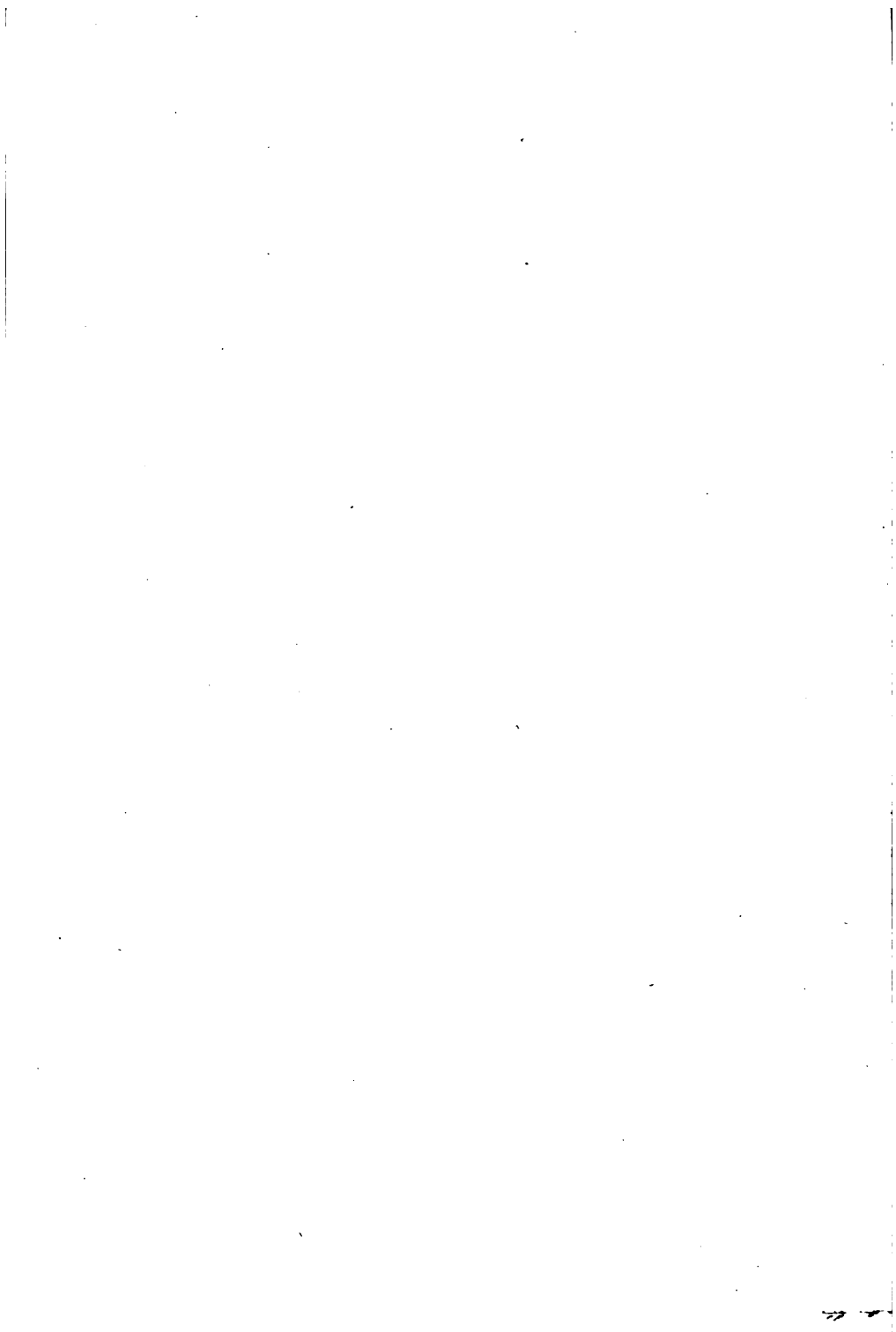
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THE CONVOLUTIONS
OF
THE HUMAN BRAIN
—
ECKER







THE CONVOLUTIONS
OF
THE HUMAN BRAIN

ON
THE CONVOLUTIONS
OF
THE HUMAN BRAIN

BY
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165. e. 20.

"Ich schau' in diesen reinen Zügen
Die wirkende Natur vor meine Seele liegen"

GOETHE, *Faust*

'Jeder Mensch ist eine psychische wie physische Formel,
ein physisches und psychisches Glied in der unendlichen Welt
der Körper und Geister'

HUSCHKE, *Schädel, Hirn, und Seele*

N O T E

THE subjoined description of the Convolutions of the adult human Cerebrum is intended to facilitate a due understanding of the same—the knowledge of their type, that is to say, of the general in the particular. It has been supported especially by numerous investigations into their development in the foetus, which are published in detail elsewhere. The author, while most fully recognising the great progress which has been made in such knowledge through the study of the brain of the apes, is nevertheless of opinion that, in order to arrive at a complete understanding of the subject, very much more attention must still be directed to the history of the development of the convolutions than has hitherto been done. This description has been framed with especial view to the needs of the physician, and is intended to enable him, when at the post-mortem table, the better to shape his course through the seeming chaos of convolutions, so that he may be capable of registering with accuracy the all-important observations upon the pathological changes in the cortex of the cerebrum. Though it be, of course, meet and right that Anatomy should not be the handmaid of Medicine, it cannot, nevertheless, be

denied, on the other hand, that she would do well to present the results of her enquiries—with the increase in value of which she is chiefly concerned—in such shape as will promote their utilisation; but it is specially in the present instance that the egoism of the anatomist is almost greater than his love for his neighbour.

P R E F A C E

It is into the hands of the physician that the great problem of an organography of the brain-husk, or, in other words, of an anatomico-physiological cognizance of the psychical organs of the brain, is for the most part entrusted; seeing that it is only by accurate clinical study combined with the most careful post-mortem observations that we shall be enabled by degrees to arrive at a knowledge of the physiological significance of each separate convolution of the brain-surface.

The difficulties which stand in the way of a solution of this problem are numberless, not the least of these being one which is inherent in the very study of the convolutions, viz. the difficulty of recognising a constant unity of form which underlies the multiplicity of individual variations. Looked at from this point of view, it becomes first the task of the anatomist to place in the hands of the physician materials by the aid of which he may be enabled easily 'to take observations' in the midst of the apparent chaos of convolution which obscures his track. Then, and only then, will the physician be in a position duly to register the observations which he has made upon the dead body. The anatomist will not be

entirely free from egoism if, in rendering this service to the physician, he look for from the latter, as a service in return, material out of which may one day proceed the much-desired knowledge.

To this end I have long had in view, for the use of the physician, a survey in detail of the convolutions of the brain, and I am still of opinion that the carrying out of the same has been in no wise rendered a work of supererogation by the recent publication of admirable memoirs in this line of research. The following treatise, which is founded throughout on my own investigations, is in particular supported by study of the development of the cerebral convolutions in the foetus, the more detailed results of which will find their publication elsewhere.¹ The accompanying illustrations should be considered less in the light of pictures than of maps by the aid of which the traveller will be in a position the better to shape his course in the district which he is exploring.

ALEXANDER ECKER.

FREIBURG: *March* 1869.

¹ 'Zur Entwicklungs-Geschichte der Furchen und Windungen der Grosshirn-Hemisphären im Fötus des Menschen,' *Archiv für Anthropologie*, Bd. iii. 1868. Transl.

TRANSLATOR'S PREFACE

'What work nobler than transplanting foreign Thought into the barren domestic soil; except, indeed, planting Thought of your own, which the fewest are privileged to do?'—CARLYLE, *Sartor Resartus*.

As the introductory remarks of the author are sufficiently exhaustive, any addition to these may seem somewhat superfluous; however, a few words from a translator are not without precedent.

The Translator claims no special qualifications for his task further than a moderate acquaintance with a foreign tongue, acquired mainly in the land where such language is spoken; and a *penchant* for the subject itself, dating from his student days in the University Museum at Oxford, where he first learned to regard man, *quoad* his brain, as 'archencephalous,' next, with apostate vision, to discern the 'posterior cornu' and the smaller Hippocamp in the ape brain, and then to slowly spell out, with indifferent knowledge of the French tongue, the contents of Professor Gratiolet's great work.

The much-desired establishment of a 'science of the localisation of the psychical functions,' to which Professor Ecker alludes in his Introduction, is a problem for the

solution of which we need hardly wait until the next century, seeing that the clods which have hitherto obstructed germination in this field are already in process of being broken up, thanks to the researches of Fritsch and Hitzig in Germany, and to the more recent experiments of Ferrier in this country.

That which seems now most urgently to be needed is some comparative nomenclature to which every mammalian brain may be referred, be it rich in a luxuriance of convolutions, or be it hardly able to lift itself above the level of the bird brain by the possession of the merest rudiment of a gyrus or sulcus. Such a want was brought more especially home to the Translator, when he was witnessing the experiments of Dr. Ferrier, it being desired, on one occasion, to give such names to the convolutions of the brain of a cat or dog as would convey a definite meaning to anyone conversant with the more recent terminology of the human cerebrum.

Until, then, such nomenclature be framed—a task to which the Translator intends, as soon as may be, to apply himself—until every mammal that can lay claim to the possession of the simplest gyrus or sulcus can express the same in terms of the human brain—any experiment made upon the brain of such animal runs a risk of being deemed wanting in exactness, especially by such as are reluctant to accept as applicable to man the results of experiments carried out on the lower animals.

For valuable assistance in the preparation of the Bibliography—a labour which only those accustomed to

research can sufficiently appreciate—the Translator is indebted to his friends Professor Rolleston, of Oxford, and Professor Murie, of the Royal Veterinary College, Edinburgh.

It cannot fail to be noted how very scanty is the American literature on the subject. This may, however, be only a seeming meagreness due to a limited circulation of American as compared with French and German periodicals in this country.

The 'Cheiroptera,' it will be seen, are conspicuous by their absence. This is the more remarkable when considered in comparison with the 'Edentata'—a group which, to judge from the little which is known of the visceral anatomy of its members, would hardly be expected to have so full a brain-bibliography as it possesses.

It has been found convenient, in accordance with the most modern system of classification, that man should share with the monkeys the order 'Primates.'

Many mammalian brains, the convolutions of which have not been as yet accurately described or figured, may be seen in the first gallery—left side—in the inner room of the Museum of the Royal College of Surgeons of England. Unfortunately, however, the series—which range from 1323* to 1341 r—is not yet completely catalogued. A large collection of casts of the interior of the crania of various mammals, similar to such as served for the foundation of many of Gervais' figures, will be found on the left side of the statue of John Hunter in the first room of the same Museum.

The collection of mammalian brains in the University Museum at Oxford, though smaller than those in the Royal College of Surgeons, is, nevertheless, very rich in simian types, and possesses, moreover, a very desirable adjunct in the shape of a full manuscript catalogue from the pen of Professor Rolleston, drawn up at about the period at which Gratiolet's work made its appearance.

J. C. G.

WEST RIDING ASYLUM :
June 1873.

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EXPLANATION OF THE LETTERING OF THE FIGURES

F. Frontal Lobe	L.e. Lobulus extremus
P. Parietal Lobe	po. Fissura parieto-occipitalis
T. Temporo-sphenoidal Lobe	o. Sulcus occipitalis transversus
O. Occipital Lobe	o ₂ Sulcus occipitalis inferior—o ₁
S. Fissure of Sylvius	being identical with the posterior division of the sulcus interparietalis
S' Posterior, or horizontal, ramus of the Sylvian Fissure	T ₁ Gyrus temporalis superior, s. primus, s. inframarginalis
S'' Anterior, or ascending, ramus of the Sylvian Fissure	T ₂ Gyrus temporalis medius, s. secundus
A. Anterior central convolution	T ₃ Gyrus temporalis inferior, s. tertius
B. Posterior central convolution	T ₄ Gyrus occipito-temporalis lateralis, s. Lobulus fusiformis
c. Central fissure	T ₅ Gyrus occipito-temporalis medialis, s. Lobulus lingualis
F ₁ Gyrus frontalis superior	t ₁ Sulcus temporalis superior
F ₂ Gyrus frontalis medius	t ₂ Sulcus temporalis medius
F ₃ Gyrus frontalis inferior	t ₃ Sulcus temporalis inferior
f ₁ Sulcus frontalis superior	t ₄ Sulcus occipito-temporalis inferior, s. collateralis
f ₂ Sulcus frontalis inferior	cm. Sulcus calloso-marginalis
f ₃ Sulcus præcentralis	oc. Fissura calcarina
f ₄ Sulcus olfactorius	oc' Upper ramus of the Calcarine Fissure
f ₅ Sulcus orbitalis	oc'' Lower ramus of the Calcarine Fissure
P ₁ Lobulus parietalis superior	h. Fissura Hippocampi
P ₂ { Lobulus parietalis inferior	Gf. Gyrus fornicatus
{ Gyrus supramarginalis	H. Gyrus Hippocampi
P _{2'} Gyrus angularis	U. Gyrus uncinatus
ip. Sulcus interparietalis	
P _{1'} Præcuneus	
Oz. Cuneus	
Oz' Convolution of the Cuneus	
O ₁ Gyrus occipitalis primus	
O ₂ Gyrus occipitalis secundus	
O ₃ Gyrus occipitalis tertius	
D. Gyrus descendens	

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¹ The authorities marked with an asterisk (*) are given in Professor Ecker's Bibliography; and the references scattered throughout the text, especially in the foot-notes, are to these works, and these alone. It must be noted that the references here given are solely confined to works in which the convolutions of the brain are described or figured, and not to such as deal only with other parts of this organ, *e.g.* the ganglia and commissures.—
TRANSL.

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- OWEN.—On the 'Aye-aye' (*Chiromys*). *Trans. Zool. Soc.*, vol. v., p. 33. Plate XXIV., giving 4 figures, *inter alia*, of the brain.
- * PANSCH.—De sulcis et gyris in cerebris simiarum et hominum. Kiel, 1866, 4to, with a plate.
- PANSCH.—Ueber die typische Anordnung der Furchen und Windungen auf den Grosshirnhemisphären des Menschen und der Affen, *Archiv für Anthropologie*, Bd. III. (1868), s. 228, with four lithographic plates. In the last plate (Taf. VIII.) are given figures of the brain-convolutions in the newly-born and adult cat and dog respectively.
- QUAIN.—Anatomy. Part II. 7th Edit. London, 1866. pp. 529-536, and pp. 575-581.
- * REICHERT.—Der Bau des menschlichen Gehirns. Leipzig, 1859-61. 2 Bände, mit 33 Tafeln. 4to.
- REIZIUS.—Beurtheilung der Phrenologie vom Standpunkte der Anatomie aus. This is a translation into German from the Swedish of an address delivered before a meeting of naturalists in Copenhagen, 1847.
- * ROLANDO.—Della Struttura degli emisferi cerebrali. *Memorie della Reale Accademia delle Scienze di Torino*, tomo xxxv. 1831, p. 103, with 10 lithographic plates.
- * ROLLESTON.—On the Affinities of the Brain of the Orang-outang. *Nat. Hist. Rev.*, 2nd ser. vol. i., p. 211.
- * ROLLESTON.—On the Affinities and Differences between the Brain of Man and the Brains of certain Animals. *Med. Times and Gazette*, Feb. 22nd, and March 15th, 1862, with woodcuts.
- ROLLESTON.—A Letter on the distinctive characters of the Brain in Man and in the anthropomorphous Apes. *Med. Times and Gazette*, Oct. 18th, 1862 (vol. ii., p. 418).
- ROLLESTON.—A Letter in the *Athenæum* of Feb. 28th, 1863, on the distinctive Characters of the Brains of Man and of the Apes.
- SAPPEY.—Traité d'Anatomie descriptive, tome iii.: Névrologie. Paris, 1871. Des Convolutions du Cerveau, pp. 57-75, with some beautifully executed woodcuts.
- SCHÜLE.—Morphologische Erläuterung eines Microcephalen Gehirns. *Archiv für Anthropologie*, Bd. v., s. 437. Braunschweig, 1872. The paper is accompanied by a plate (Taf. VI.) of clear lithographic figures, of which Fig. 4 illustrates the brain of a fœtus of *Cebus Apella*, to which reference is made by Prof. Ecker at p. 455 of the same volume.

- SOEMMERING.—Ueber das Organ der Seele. Königsberg, 1796. The first (copper) plate gives a fair view of the convolutions on the median aspect of the brain.
- SOEMMERING.—Tabula Baseos Encephali. Francofurti-ad-Moenum. 1799. There is a beautiful plate of the base of the brain of a boy aged 3 years, but the convolutions are not very well defined.
- SOEMMERING.—Von Hirn und Rückenmark. Mainz, 1788. There are no figures, but at p. 65 some remarks are made respecting the sulci and gyri, in the course of which it is stated that, with all their seeming variability in different individuals, they have, nevertheless, great constancy, and analogy to one another.¹
- SOLLY.—The Human Brain; its structure, physiology, and diseases. 2nd Edition. London, 1847, pp. 94–132. See also p. 321 for figures of foetal brains. The comparative anatomy figures are taken mostly from Owen and Leuret.
- TIEDEMANN.—The Anatomy of the Foetal Brain. Translated from the French of A. J. L. Jourdan. Edinburgh, 1826. The work is illustrated by 14 excellent copper plates.
- TIEDEMANN.—Anatomische Bildungsgeschichte des Gehirns. Nürnberg, 1816.
- TUKE AND FRASER.—Case with a lesion involving Broca's convolution without Broca's Aphasia. *Journal of Mental Science*, April 1872, p. 46, with a plate of the left side of the brain, lithographed from a photograph.
- * TURNER.—Notes more especially on the bridging convolutions in the brain of the Chimpanzee. *Proc. Roy. Soc. Edinb.* 1865–66.
- * TURNER.—The Convolutions of the Human Cerebrum topographically considered. Edinb. 1866.²
- TURNER.—The Convolutions of the Human Brain considered in relation to the Intelligence. *West Riding Asylum Reports*, vol. iii. p. 1. 1873.
- TYSON.—Orang-outang, sive *Homo sylvestris*, or the anatomy of a Pygmie compared with that of a Monkey, an Ape, and a Man. Lond. 1699. There is no figure of the upper surface of the brain, and that of the base (Fig. 13) is not very clear.

¹ 'Ihre Form ist, im Ganzen genommen, auch in verschieden scheinenden Köpfen sich immer sehr ähnlich oder analog.'

² A pretty full review of this by the Translator will be found in the *Med. Times and Gazette*, Jan. 5th, 1867.

- VICQ D'AZYR.—*Traité d'Anatomie et de Physiologie*. Fol. Paris, 1786. No. lière. Pl. III. pp. 4 and 13. No. Sième. Pl. XVI.
- * VOGT.—Ueber die Microcephalen oder Affenmenschen, mit 26 Tafeln. *Archiv für Anthropologie*, Bd. II. s. 129.
- WILLIS.—*Opera Omnia*. Tomus Prior. Cerebri Anatome. Pp. 255–294. Lugduni. 1861. A few remarks about the convolutions; and a few, and these but very coarse, figures of the brain.
- WAGNER.—*Vorstudien zu einer wissenschaftlichen Morphologie und Physiologie des menschlichen Gehirns als Seelenorgan*. Göttingen, 1860–62, with 11 beautifully executed plates.
- WEISBACH.—Die Supraorbital Windungen des menschlichen Gehirns. *Wiener Medizin Jahrb.* XIX. (*Wiener Medizin. Zeitschr.* XXVI. 2. 3), p. 88.
- WERNER.—Verletzung des Lobus frontalis der linken Grosshirnhälfte, ein Beitrag zur Pathologie der Gehirnverletzungen und zur Localisation der Gehirnfunktionen. *Virchow's Archiv*, 5te Folge, Bd. vi. Heft 3, s. 289. 1872.

II. RODENTIA.

- DARESTE.—Note sur le Cerveau du Cabai (*Hydrochærus Capybara*, Erxl). *Comptes Rendus*, 1855, p. 199; and also *Annales des Sciences naturelles: Zoologie*, 4ième sér., tome iii. p. 355. Pl. II. Figs. 1 to 3.
- GEGENBAUR.—Grundzüge der vergleichenden Anatomie. 2te Aufl. Leipzig, 1870. The brain of a Rabbit (*Lepus cuniculus*) is figured at p. 733.
- GERVAIS.—Mémoire sur les Formes Cérébrales des Mammifères (continued). *Journal de Zoologie*, tome lière, No. 6. Paris, 1872. One plate (Pl. XXII.), giving several figures of the brains of various Rodents.
- KRAUSE.—Die Anatomie des Kaninchens. Leipzig, 1868, s. 215, with one woodcut (Fig. 24) of the superior surface of the brain of the Rabbit.
- PETERS.—Contributions to the knowledge of *Pectinator*, a genus of Rodent Mammalia from North-eastern Africa. *Trans. Zool. Soc.* vol. vii. p. 405. At Plate L. are given four figures of the brain.

- RYMER-JONES.—Article *Rodentia* in Todd's *Cyclopædia of Anatomy and Physiology*, vol. iv. pp. 391-2. The upper surface of the brains of a Porcupine and of an Agouti (both after Serres) are here represented.

III. CARNIVORA.

- BELL.—Article *Carnivora* in Todd's *Cyclop. of Anat. and Phys.*, vol. i. p. 480. The upper and lateral views of the brain of a lion are here figured.
- FLOWER.—On the Anatomy of the Aard-wolf (*Proteles cristatus*). *Proc. Zool. Soc.*, 1869, p. 474. Description of the brain at p. 478, and four woodcuts at pp. 480-1.
- FLOWER.—On the Anatomy of *Ælurus Fulgens*. *Ibid.* Nov. 15th, 1870, pp. 755-757, Figs. 1, 2, 3.
- GERVAIS.—Mémoires sur les Formes Cérébrales propres aux Carnivores vivants et fossiles. *Nouvelles Archives du Muséum*. Tome VI. p. 103, with seven plates full of capital figures.
- GERVAIS.—Forme cérébrale du *Cephalogale Geoffroyi*. *Journ. de Zoologie*. Tome I. p. 130. Paris. 1872, with a plate representing an intracranial cast of this fossil (Miocene) Carnivore.
- OWEN.—On the Anatomy of the Cheetah (*Felis Jubata*). *Trans. Zool. Soc.* Vol. I. p. 129. At pp. 133 *et seq.* is given a comparative survey of the brain in the Felidæ, and in the plate (Pl. XX.) there are three figures of the brain of this Leopard, and also three figures, for purposes of comparison, of that of the domestic cat.

IV. CETACEA.

- BURMEISTER describes and figures the brain of *Pontoporia Blainvillii* (Gray) in the *Annales del Museo Publico de Buenos Aires*. Tome I. p. 431. Plate XXVIII. Figs. 1 and 2.
- CUVIER, F.—Article *Cetacea* in Todd's *Cyclop. of Anat. and Phys.* Vol. I. p. 582. The upper and lower surfaces of the brain of *Delphinus Delphis* are here figured.
- GERVAIS.—Remarques sur l'Anatomie des Cétacés, de la division des Balénides. *Nouvelles Archives du Muséum*. Tome VII. p. 124, with three plates of the brains of this division of whales.

V. SIRENIA.

BRANDT.—*Symbolæ Sirenologicae. Mém. de l'Acad. Imp. des Sciences de St. Pétersbourg. Sér. 7. Tome XII (1868) pp. 284, &c. Pl. IX. Fig. 1, Manatus. Fig. 2, Halicore. Fig. 3, Rhytina.* These are shaded outlines with reference to the shape of the upper surface of the brain, rather than to the convolutions, somewhat resembling, but not so good as Gervais' casts. At p. 284 *Rhytina* is more particularly mentioned, only curt allusion being made to the others in the summary of characters.

MURIE.—On the Form and Structure of the Manatee (*Manatus Americanus*). *Trans. Zool. Soc. Vol. III. (Pt. III. Sept. 1872), p. 183, and Pl. XXV.,* in which five figures of the brain are given. Dr. Murie considers of the brain of this mammal 'as a whole, that in shape and type of gyri, &c., it appears to follow more that of the Elephant than those of Cetacea generally.'

VI. UNGULATA.

a. PERISSODACTYLA.

LEISERING.—Atlas der Anatomie des Pferdes. Leipzig. 1861-66. At Taf. XXVI. of this exquisitely illustrated work upon the anatomy of the horse are given figures of the brain of this animal. The convolutions, however, are not very distinctly marked. Neither the figures given in the plates of the Atlas appended to Prof. Gurlt's *Handbuch der vergleichenden Anatomie der Haus-säugethiere* (Berlin, 1860) nor the woodcuts in Chauveau's *Traité d'Anatomie comparée des animaux domestiques* (Paris, 1871) are so distinct as those given by Leisering in his splendid work.

OWEN.—On the Anatomy of the Indian Rhinoceros (*Rhinoceros unicornis*). *Trans. Zool. Soc., vol. vi. p. 31.* Four plates deal with the brain of this Ungulate.

b. ARTIODACTYLA.

DARRESTE describes and figures the brain of the Javanese Musk-deer (*Tragulus Javanicus*, Pall. P) in the *Annales des Sciences naturelles: Zoologie*, 4ième sér. tome iii., p. 360. Pl. III.

GRATIOLET.—Recherches sur l'Anatomie de l'Hippopotame (publiées par les soins du Dr. Edmond Alix). Paris, 1867, pp. 316-349, and Pl. XII. Figs. 1-9.

- MILNE-EDWARDS (ALPHONSE).—Recherches anatomiques, zoologiques et paléontologiques sur la Famille des Chevrotains. *Annales des Sciences naturelles: Zoologie*, 5ième Série, tome ii. p. 49. Pl. VI. is made up of seven fairly clear lithographic figures of the brains of *Moschus*, *Tragulus*, *Cainotherium*, and *Hyæmoschus*.
- OWEN.—On the Anatomy of the Nubian Giraffe. *Trans. Zool. Soc.* vol. ii. p. 217. Three figures of the brain are given in two lithographic plates (Plates XLIII., XLIV.).
- PETERS.—Ueber das Gehirn des Nilpferdes (*Hippopotamus amphibius* Linn.) *Monatsberichte*. Berlin, 1854.

VII. HYRACOIDEA.

- BRANDT.—Untersuchungen über die Gattung der Klippschliefer (*Hyrax*, Herm.). *Mémoires de l'Acad. Imp. des Sciences de St.-Petersbourg*, 7ième série, tome xiv. There are no figures of the brain, but there is a meagre description of the convolutions at p. 46.

VIII. EDENTATA.

- ALESSANDRINI.—Cenni sull' Anat. del *Dasipo minimo*, Desm. *D. 6 cinct. et 8 cinct. Linn. Mem. dell' Accad. delle Scien. d'Inst. di Bologna*, tomo vii. (1856), p. 285. Tab. XVII. Figs. 9 and 10.
- GERVAIS.—Mémoire sur les Formes cérébrales propres aux Édentés vivants et fossiles. *Nouvelles Archives du Muséum*, tome v., p. 1, with five plates of numerous figures.
- HYRTL.—Chlamydophori Truncati cum Dasypode Gymnuro comparatum examen anatomicum. *Denkschrift der mathem. naturwiss. Cl. der k.k. Akad. in Wien*. Bd. IX. No figures, unfortunately, are given of the brain, the gyri of which are simply described as 'rari, parum elevati, ampli.'
- POUCHET.—Mémoire sur l'Encéphale des Édentés. *Ch. Robin's Journal de l'Anatomie et de la Physiologie*, 1868, p. 658. Pl. I. II., and 1869, p. 1. Pl. III. IV. V. VI. But very few out of the numerous figures are taken from casts of the interior of the cranium, the greater part being derived from dissections of the brains themselves.

RAPP.—Anatomische Untersuchungen über die Edentaten, 2te Auflage (Tübingen, 1852), s. 52. At figs. 2 and 3 of Taf. VIII. are represented the brains of *Bradypus cuculliger*, Wagl., and *Dasy-
pus Peba* respectively. While that of the latter appears to be almost absolutely smooth, the brain of the former is comparatively rich in convolutions.

TURNER.—On the Brain of *Dasy-
pus sexcinctus*. *Journ. of Anat. and
Phys.*, 1st ser. 1867, p. 313.

WINKER.—Dissertatio sistens observationes anatomicas de Tatu novemcincto. Tübingen, 1826.

IX. MARSUPIALIA.

GERVAIS.—Mémoire sur les Formes cérébrales propres aux Marsupiaux. *Nouvelles Archives du Muséum*, tome v. p. 229, with 2 plates.

OWEN.—Article 'Marsupialia' in *Todd's Cyclop. of Anat. and Phys.* vol. iii. p. 293. Figures of the upper surfaces of the brains of *Dasyurus ursinus* and *Macropus major* are here given.

WYMAN.—Description of the Brain of the Opossum (*Didelphys Virginiana*). *Memoirs of the Boston Society of Nat. Hist.* vol. ii. Part I. No. II. p. 151. A few woodcuts illustrate the paper.

X. MONOTREMATA.

EYDOUX AND LAURENT.—Notice sur l'encéphale de l'Échidné comparée à celui de l'Ornithorhynche. *Guérin, Mag. de Zoologie*, tome viii. p. 141. Pl. XXX.

MECKEL.—Ornithorhynchi paradoxi descriptio anatomica, fol. L'psisæ. 1826. P. 83. The cerebrum is here described as 'vix gyris sulcisque excepto in cerebello, notatum.' In Tab. VII. are given five figures of the brain. Figs. 3-7.

THE CONVOLUTIONS OF THE HUMAN BRAIN

INTRODUCTION

THAT the cortex of the cerebrum, the undoubted material substratum of our mental operations, is not a single organ, which is brought into play as a whole in the exercise of each and every psychical function, but consists rather of a multitude of mental organs, each of which is subservient to certain intellectual processes, is a conviction which forces itself upon us almost with the necessity of a claim of reason. The hypothesis set up in opposition to it, of a single organ for the carrying out of the multiplicity of psychical functions, would present about an equivalent point of view to that of 'vital force,' which has received its *coup de grâce*. If, however, as we conceive to be an undoubted fact, certain portions of the cortex of the cerebrum subserve certain intellectual processes, the possibility is at once conceded that we shall some day arrive at a complete organography of the surface of the

brain—a science of the localisation of the psychical functions. Such an one as this—that is to say, a knowledge of the psychical organs of the brain, in all their relations—is certainly one of the most important problems for the anatomy and physiology of the next century, the solution of which is destined to bring about no small revolution in Psychology. That such problem still faces us as one almost completely unsolved, is brought about, indeed, by various causes; and without doubt men have been deterred more than is reasonable from treading this path by the want of success which has attended the first serious investigation into a localisation of the functions of the mind. Even though Gall had originally struck upon the right path—that of a careful study of the brain—he, nevertheless, quitted it very early, and, making the fact, which in general holds perfectly good, that the outline of the skull adapts itself to the form of the contained brain, his starting point, rested upon the belief that for laborious and rare investigations into the brain of the dead could be substituted observations carried out upon the scalps of the living. Bringing certain bumps, or knobs, on the skull into relation with certain mental dispositions, to which end, moreover, he had already, while a young man, collected material, he now set a going, with the aid of his pupil Spurzheim, a system of Phrenology, in which the brain had but little more attention paid to it, and that of such a character as to be quite incapable of a scientific completeness of construction. The Science of Phrenology, so called, has, as a consequence, remained, ever since its origin, stationary at the same stand-point, and has passed over from the earnest inquirers into natural truths—in particular the anatomists and physiologists,

who, with justifiable contempt, have turned their backs upon it—into quite different hands. One is familiar with the peripatetic professors of Phrenology, who go their rounds with plaster-of-Paris heads of Schiller, Napoleon, or some notorious criminal or other, and out of a number of items of skull bumps run up a sum-total of character. Few, indeed, of such fellows have ever seen a brain in their lives.

But it was not only the reaction from the miscarriage of this first experiment which checked a successful progress upon the road already indicated, but there were actually wanting the needful preliminaries thereof. Notwithstanding the certain conviction that the cortex of the cerebrum was the organ of the mind, and spite of the strong inducement to anatomical study of the convolutions of the brain which would arise therefrom, such study has up to the most recent period been very much neglected, or rather, one should say, there was wanting the guiding thread by which to find one's way aright in this labyrinth. For men were wont to regard the convolutions as a series of folds without order or arrangement, and draughtsmen represented them much as they would a dishful of macaroni. It was only by degrees that certain sulci and gyri came to be recognised as more constant than others; but so long as attention was confined only to the fully-developed human brain, real progress was not possible. Comparative Anatomy and the History of Development—those beacons of Human Anatomy—have been also the first to shed light upon this dark corner; for it was the labours of Huschke and, in particular, of Gratiolet, directed toward the brain of apes, that have established the conformity, in structural style, of the brain of apes

with that of man, and have thereby for the first time paved the way towards a comprehension of the latter. Since, however, everything can only be comprehended of itself, and every being out of its evolution, so must certainly the tracing of the history of the development of the human convolutions be the way in which alone can a correct insight into their nature be gained. For, however great a similarity exists between the human and the simian brain, particularly that of the higher apes, one and the same with the latter it certainly is not; for which reason it is that this path has been already trodden by various inquirers, such as Gratiolet, Reichert, and Bischoff, and that the following sketch of the convolutions has been founded throughout upon the study of their development in the foetus. There can be no question but that this is the only way to learn some day or other to recognise a law for the formation of the convolutions—that is to say, to learn to recognise and comprehend the formation of the convolutions as a necessary consequence of certain mechanical antecedents in the growth of the brain and skull. But as yet we are a long way off from knowledge of such sort. The origin of the fissure of Sylvius was the soonest to open out comprehension in this sense. The relations which exist between the arrangement of the arterial vessels of the brain and the convolutions, to which Reichert has directed attention, are most certainly not without significance; and that is, moreover, quite correct which Bischoff (*loc. cit.* s. 34) states—that a large number of the gyri of the central hemispheres are arranged about the ends of the primary fissures in curves of a greater or less degree of complexity, which can hardly be otherwise, since the mountain curves which bound a valley must,

where the latter terminates, of necessity pass into one another; but a particular understanding of this appears, nevertheless, not as yet to have been manifested.

If we make a preliminary survey of the arrangement of the convolutions, entirely as a whole, we shall find them to be differentiable, first into primary convolutions ('Hauptwindungen'), then into secondary ones ('Nebenwindungen'), and, finally, into tertiary convolutions.¹

The primary convolutions, or gyri, resemble large mountain ridges, the sinuosities of which, as has been rightly remarked, give a region its characteristic features. The secondary convolutions originate from the differentiation of a primary convolution, through the formation of longitudinal fissures, into narrower secondary gyri, so that simultaneously with the formation of longitudinally running valleys, secondary mountain-ranges are brought into existence.

The deep furrows which separate the primary convolutions from each other we may term primary sulci, while those by which the secondary gyri are divided off from one another may be termed secondary sulci. Finally, the term tertiary convolutions may be applied to those small spurs which run out into a primary fissure from the valley sides of the primary convolutions, and which, interdigitating generally with those of the opposed side, give to the bottom of the valley, or fissure, a zigzag course. This cannot be distinctly seen until the edges of the primary sulci have been drawn asunder; but in brains, the primary convolutions of which have shrunk through senile or some other atrophy, through the great infiltration

¹ Compare in particular Reichert, *loc. cit.* ii., s. 86. Rolleston, *Med. Times and Gazette*, 1862, vol. i. p. 259.

of the *pia mater*, they come directly into view. While the sinuosities of the primary convolutions are always pretty regularly disposed, there exist in the region of the secondary and tertiary gyri numerous variations; in the first place, because now only a few, now many secondary fissures make their appearance—to wit, that which conditions the varying wealth of convolutions, and next, because in the one case tertiary gyri, previously concealed, attain the surface, and in the other case, convolutions, which would otherwise have a superficial position, sink down to the bottom. In the first event fissures are bridged over, in the latter case they come into existence in places where there were previously none at all.

*THE SULCI AND CONVOLUTIONS OF THE
CORTEX OF THE CEREBRUM.*

Each hemisphere of the cerebrum may, as is well known, be incompletely divided, by sections more or less deep, into several divisions or lobes, which Burdach¹ was the first to recognise more distinctly—to wit, as Anterior Lobe ('Vorderlappen,' *Lobus anterior*), Upper Lobe ('Oberlappen,' *Lobus superior*), together with the *Operculum* ('Klappdeckel'), Lower Lobe ('Unterlappen,' *Lobus inferior*), and the Island of Reil ('Stammlappen,' *Lobus caudicis*).

Arnold,² however, instead of these terms, preferred to take the principal environing bones as boundaries, which landmarks are to this day in universal use.

On this plan, then, the following territories are recognised by anatomists :—The Frontal Lobe ('Stirnlappen,' *Lobus frontalis*), Parietal Lobe ('Scheitellappen,' *Lobus parietalis*), Temporal Lobe ('Schläfenlappen,' *Lobus temporalis*)—also termed Sphenoidal Lobe ('Keilbeinlappen,' *Lobus Sphenoidalis*), or Temporo-sphenoidal Lobe ('Schläfen-Keilbeinlappen,' *Lobus temporo-sphenoidalis*)—and the Occipital Lobe ('Hinterhauptlappen,' *Lobus occipitalis*). That lobe—the 'Stammlappen' of Burdach—which does not stand in immediate relation

¹ *Loc. cit.* Bd. ii. s. 169 *et seq.*

² Bemerkungen über den Bau des Hirns und Rückenmarks, s. 61. *Handbuch der Anatomie*, ii. 2, s. 727.

with the capsule of the skull, passes by the name either of the Island ('Insel,' Reil), or of the Intermediate or Hidden Lobe ('Zwischenlappen' or 'Versteckterlappen,' *Lobus intermedius sive opertus*, Arnold), or of the Central Lobe ('Centrallappen,' *Lobus centralis*, Gratiolet).

The frontier lines which bound off the several lobes from one another are only clearly laid down on certain surfaces, while on others the lobes encroach upon each other without the intervention of distinct boundary lines.

I shall first proceed to the consideration of the primary sulci ('Hauptfurchen'), through the medium of which the several lobes are divided off from one another; next of each lobe *seriatim*; and, further, of the recognisable secondary sulci by which each may be subdivided into its constituent lobules and convolutions.

The sulci are invariably the most important factors, and, consequently, those to which consideration will at all times be directed; for it is these which show the clearest the development of the surface of the brain in the foetus, seeing that it is the primary sulci which are the first to divide the same into a number of districts, and that the very existence of the convolutions can only take place by the further advance and development of the formation of the sulci.

The following, then, are the principal frontier sulci:—

I. PRIMARY SULCI.

1. *The Fissure of Sylvius (Fissura sive Fossa Sylvii, S).*

This important fissure, by which one of the main divisions of the cerebral hemispheres is bounded, can in no wise be considered in the same category as the rest of the

Primary
sulci.
Fissura
Sylvii.

sulci on the surface of the brain ; for whereas these latter consist simply of depressions in, or folds of, the cerebral

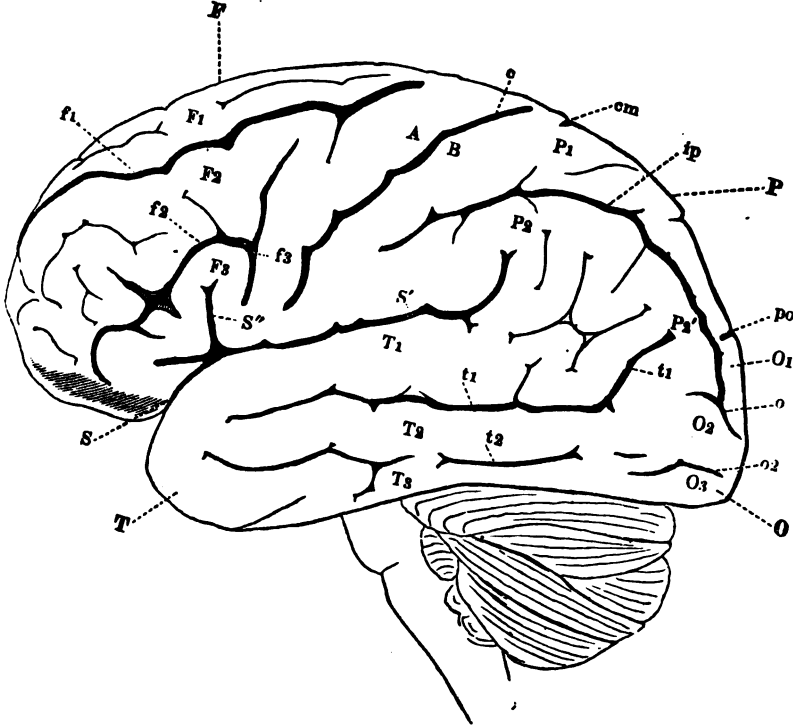


FIG. 1.—LATERAL VIEW OF THE BRAIN. F. Frontal Lobe. P. Parietal Lobe. O. Occipital Lobe. T. Temporo-Sphenoidal Lobe. S. Fissure of Sylvius. S' horizontal, S' ascending ramus of the same. c. Sulcus Centralis. A. Anterior, B. Posterior Central Convolution. F. Superior, F. Middle, F. Inferior Frontal Convolution. f. Superior, f. Inferior Frontal Sulcus. f. Sulcus Fræcentralis. P. Superior Parietal Lobule. P. Inferior Parietal Lobule, vis. P. Gyrus Supramarginalis. P. Gyrus Angularis. ip. Sulcus Interparietalis. cm. Termination of the Callosomarginal Fissure. O. First, O. Second, O. Third, Occipital Convolution. po. Parieto-occipital Fissure. o. Sulcus Occipitalis transversus. o. Sulcus Occipitalis longitudinalis inferior. T. First, T. Second, T. Third, Temporo-Sphenoidal Convolution. t. First, t. Second, Temporo-sphenoidal Fissures.

cortex, formed at a comparatively late period of foetal existence, the former has already come into existence at the third month, and, moreover, in an entirely different

way, viz., by the folding together of the entire hemisphere into an arch, having its concavity downwards, round about the point of entrance of the crus cerebri.¹

The *Fissura Sylvii* begins at the base of the cerebrum, behind the origin of the olfactory nerves, laterally to the *Chiasma nervorum opticorum* in the anterior perforated space ('Siebplatte'), and runs laterally thence, gradually narrowing, till it reaches the vaulted lateral surface of the hemisphere. Here it at once divides into two rami—an anterior shorter one, which, steeply ascending, runs anteriorly in the direction of the Frontal Lobe (*Ramus ascendens sive anterior S''*), and a much longer posterior ramus (*Ramus posterior sive horizontalis S'*), which takes a direction towards the posterior portion of the Parietal Lobe. The upper extremity of either arm is at times undivided, but sometimes radiates into several secondary sulci, and becomes surrounded by the bridge-like tracks of convolutions.

Between these two rami depends the *Operculum* ('Klappdeckel'), which is mostly made up by the lower extremities, which become fused together, of the two

¹ Through such curvature there is formed at the inferior surface of each hemisphere a shallow open depression, the *Fossa Sylvii*, which divides off the hemispheres into an anterior and a posterior section. Since this fossa, in its course from the lower to the lateral surface, takes a direction, first upward, and then upwards and backwards, it comes to separate off the frontal and parietal lobes from the temporal lobe. At a later period—at the sixth month—the elliptical fossa takes on, from the development of the anterior ascending ramus, a triangular form; and whereas now the three cerebral lobes, namely, the frontal, parietal, and temporal, with their oppositely-directed margins—the first with its posterior, the second with its inferior, and the third with its upper margin—all tending towards a common middle point, have grown into close contact, the bottom of the fossa in question—made up by the Island—comes to be gradually covered in, and the originally widely open fossa, the Sylvian fossa (*Fossa Sylvii*), transformed into a narrow fissure, the Fissure of Sylvius (*Fissura Sylvii*).

Central convolutions, and by a small portion of the Inferior Frontal convolution and of the lower Parietal Lobule, and goes to form the roof of the Island of Reil. This territory sinks down into the angle of the Y, which is formed by the divergence of the two rami of the Sylvian fossa.

2. *Sulcus Centralis*. 'Centralfurche,' Huschke (c).

*Sulcus
Centralis.*

Syn. Scissure de Rolando. Leuret.

Fissura transversa anterior. Panach.

Postero-parietal sulcus. Huxley.

This sulcus, which, though it may have been mentioned earlier, Rolando was the first clearly to describe, is, without exception, always present in the human brain; and it is, moreover, characteristic of the latter, as well as of the brains of most apes, that this is one of the first, though not actually the first, sulcus to make its appearance in the foetal brain; seeing that it is usually recognisable at so early a period as the end of the fifth month. By reason of the so great constancy of its presence, and because it is never—or at most, but very rarely—bridged over in its course by a secondary convolution,¹ it forms the most certain starting-point for the examination of the convolutions.

It begins close to the median edge of the hemisphere, and from here takes a course obliquely forwards and downwards, to terminate in the neighbourhood of the upper margin of the posterior ramus of the Sylvian fissure,² the

¹ This rare variation, which has never been observed even by Turner (*loc. cit.* p. 10) or by Bischoff (*loc. cit.* p. 39), will be found in a figure of the brain of the clinical teacher Fuchs, given by Wagner (*loc. cit.* 2 *Abhandlung*, Taf. I.).

² A complete debouchement of the Central Sulcus into the Fissure of Sylvius, such as is described by Turner (*loc. cit.* p. 12), has not as yet come under my observation.

with it, attains a higher degree of development ; the very position of the sulcus in its entirety seeming sometimes, under the above-mentioned conditions, to be displaced more posteriorly. For the whole of its length the sulcus is bounded by two convolutions—the anterior and posterior central convolutions (*A. B. Fig. 2*), which, at both ends of the sulcus, namely, at the median edge of the hemisphere and at the upper margin of the *Fissura Sylvii*, pass, archwise, into one another.

This sulcus forms on the upper surface of the hemisphere a natural frontier line between the Frontal and Parietal Lobes, and so I reckon the anterior of the central convolutions as belonging to the Frontal, and the posterior to the Parietal Lobe.¹

3. *Fissura Parieto-occipitalis* (*po*).

*Fissura
Parieto-
occipitalis.*

This sulcus, which separates the Parietal off from the Occipital Lobe, cuts, from the upper median edge of the hemisphere outwards, more or less deep into the latter, and accordingly appears as well upon the upper as upon the lower median surface of the hemisphere, and is consequently reckoned as much among the sulci of the latter as among those of the former, and comes also in both places under a different designation. That such division is purposeless, and readily gives occasion for misunderstanding, is sufficiently evident ; and I would, therefore, regard the entire fissure as but one, and describe it by

¹ Gratiolet, Bischoff, and others put the anterior central convolution as well under the category of the convolutions of the parietal lobe. This view appears to me to have particularly little to recommend it, for the reason that while the convolution in question is in very intimate relation with those of the frontal lobe, it has, on the other hand, almost no connection at all with the convolutions of the parietal lobe.

the above name, but would subdivide it, however, into two portions—a median and a lateral portion.

a. Pars Medialis sive verticalis Fissuræ Parieto-occipitalis ('Der mediale Theil').

Syn. Fissura posterior. Burdach.¹ Arnold.²

Scissure perpendiculaire interne. Gratiolet.

Occipito-parietal fissure. Huxley.

Fissura occipitalis, sive posterior. Senkrechte hintere Hirnspalte. Wagner.

Fissura occipitalis interna. Pansch.

Fissura occipitalis perpendicularis interna. Bischoff.

Internal perpendicular fissure. Marshall.

This deep and most constant sulcus, the first, together with the *Fissura calcarina*, which appears (at the fourth, or at the beginning of the fifth month) in the foetus, runs from the upper median edge of the hemisphere out upon the plane vertical median surface of the same, forwards and downwards in an anteriorly concave curve, and makes up an acute angle by fusion with the Calcarine fissure.

This sulcus divides—herefrom deriving its name—the Parietal Lobe (in particular the upper middle Parietal Lobule—*Præcuneus*) off from the Occipital Lobe (in particular the *Cuneus*).

β. Pars Superior sive Lateralis Fissuræ Parieto-occipitalis ('Der obere und laterale Theil').

Syn. Scissure perpendiculaire externe. Gratiolet.

Occipito-parietal fissure. Huxley.

External parieto-occipital fissure. Turner.

¹ *Loc. cit.* ii. 166. Taf. vii. β. γ.

² *Hirn und Rückenmark*, s. 51.

External perpendicular fissure. Marshall.

Fissura occipitalis interna. Pansch.

Fissura occipitalis perpendicularis interna. Bischoff.

While the median portion of the *Fissura Parieto-occipitalis* appears to be always uniformly and distinctly developed, it is this lateral portion that remains in a very varying grade of development. For this portion of the sulcus frequently appears only in the shape of a slight notch at the upper margin of the hemisphere, which derives importance solely from its relation with the median portion; while, at another time, it extends itself laterally, in the shape of a transverse sulcus, over a considerable extent of the hemisphere. The lateral extremity of the sulcus is always skirted by a bridge-like convolution—*Gyrus occipitalis primus* (O_1)—which passes over from the *Præcuneus* to the *Cuneus*, and is always recognisable at a very early period in the foetal brain.

II. THE LOBES OF THE BRAIN. THEIR SULCI AND GYRI.

A. *Lobus Frontalis* ('Stirnlappen').

Frontal lobe.

The Frontal Lobe consists of that portion of the hemisphere which lies anteriorly in the cavity of the frontal bone—though posteriorly it transgresses the boundary formed by the coronal suture—and which rests upon the roof of the orbital cavity, and presents upon transverse section a somewhat triangular shape. On it may be distinguished a vaulted upper and lateral surface, a lower surface—that resting upon the roof of the orbital cavity—slightly concave, and, lastly, a median plane surface lying against the corpus callosum. The inferior surface

enters into the formation of a triangle corresponding to the *pars orbitalis* of the frontal bone, of which the base is directed anteriorly and the apex posteriorly. The French authors, who are those most generally followed, have erroneously described these various surfaces partially as special lobes, and have thus designated the inferior orbital surface as *Lobule orbitaire*, the superior and lateral one as *Lobe frontal*, while they include the median surface and that of the Parietal Lobe together under the term *Lobe fronto-pariétal*.

The boundaries of the Frontal Lobe are formed, on the upper and lateral surface by the *Sulcus Centralis*, which divides off the above lobe from the Parietal one, and upon the inferior surface by the horizontally running origin of the Sylvian fissure and the *Substantia perforata lateralis*, which separate the lobe in question from the Temporal Lobe. On the median surface a well-marked line of demarcation from the Parietal Lobe is not recognisable.

GYRI AND SULCI OF THE FRONTAL LOBE.

I. CONVOLUTIONS.

Gyrus
Centralis
Anterior.

a. *Gyrus Centralis anterior* ('Vordere Centralwindung,' Huschke). (A.)

Syn. Processi enteroides verticali di mezzo (the anterior portion of the above) Rolando. Circonvolution transversale pariétale antérieure. Foville.

Premier pli ascendant. Gratiolet.

Antero-parietal gyrus. Huxley.

Ascending frontal gyrus. Turner.

This constant convolution bounds the Central Fissure—see description of the latter—anteriorly, and runs as well

above as below—*i.e.*, fuses at either end of the fissure with the posterior Central convolution.

b. Anteriorly there pass sinuosities from the anterior Central convolution—the Frontal convolutions—which run anteriorly toward the tip of the hemisphere, and, after here curving round to the inferior surface of the same, converge towards, and finally end at the posterior apex of the triangle which is formed by the inferior surface of the Frontal Lobe. Anatomists are wont to distinguish three superimposed tracks or stages of convolutions.

1. *Gyrus Frontalis superior* (and *Gyrus rectus* on the lower side) 'Erste oder obere Stirnwindung' (F_1). Gyrus frontalis superior.

Syn. Étage frontal supérieur ou troisième (and Pli de la zone externe). Gratiolet.

Supero-frontal gyrus. Huxley.

This convolution takes its origin from the upper (median) portion of the anterior Central convolution by one or more roots. The origin is mostly a direct and superficial one, and is but seldom transversely broken in its continuity by a fissure, the *Sulcus præcentralis*—see description—generally terminating much earlier. Further on in its course this convolution frequently undergoes subdivision through secondary sulci, but the disjoined factors run together again; and since sometimes more, sometimes fewer, of such subdivisions may take place, and connexions of the same—now more, now less, developed—with the Frontal convolution next to be described, may come to be formed, there necessarily results great variation in the disposition of this convolution in various individuals.

On this convolution there may be distinguished an

upper, or lateral, and a median surface, which come into conjunction at the superior median edge of the hemisphere. The median portion of the convolution (F_1 , fig. 4)—the *Pli de la zone externe* of Gratiolet—which lies in the great Central fissure, is separated off from the *Gyrus fornicatus* ('Bogenwindung' *G.f.*) which skirts the corpus callosum, by the *Sulcus callosomarginalis* (*cm*), and is not infrequently resolvable, through the medium of a further sulcus, parallel to the one just named, into two sinuosities, superimposed the one above the other. The uppermost frontal convolution, while it curves over the anterior extremity of the hemisphere on to the inferior surface of the same, tapers considerably, and is continued, on arriving here, into a slender gyrus, running straight from before backwards, and bounding the median fissure on either side, which has been termed the *Gyrus rectus* (F_1 , fig. 3).

Gyrus
frontalis
medius.

2. *Gyrus Frontalis medius* sive *secundus* (F_2), 'Zweite oder mittlere Stirnwindung.'

Syn. Étage frontal moyen. Gratiolet.
Medio-frontal gyrus. Huxley.

This convolution proceeds from the anterior Central convolution, beneath and laterally to the one just described; but its origin is nevertheless frequently a masked one—that is, the convolution appears at its origin to be transversely notched by a sulcus, sometimes superficial, sometimes deep—the *Sulcus præcentralis*, *f* 3. In its course towards the anterior end of the hemisphere, this track, which is, as a rule, from its very origin, the widest of the three Frontal convolutions, becomes considerably wider still, and, in such

brains as are rich in convolutions, is frequently complicated to a high degree by numerous subdivisions and con-

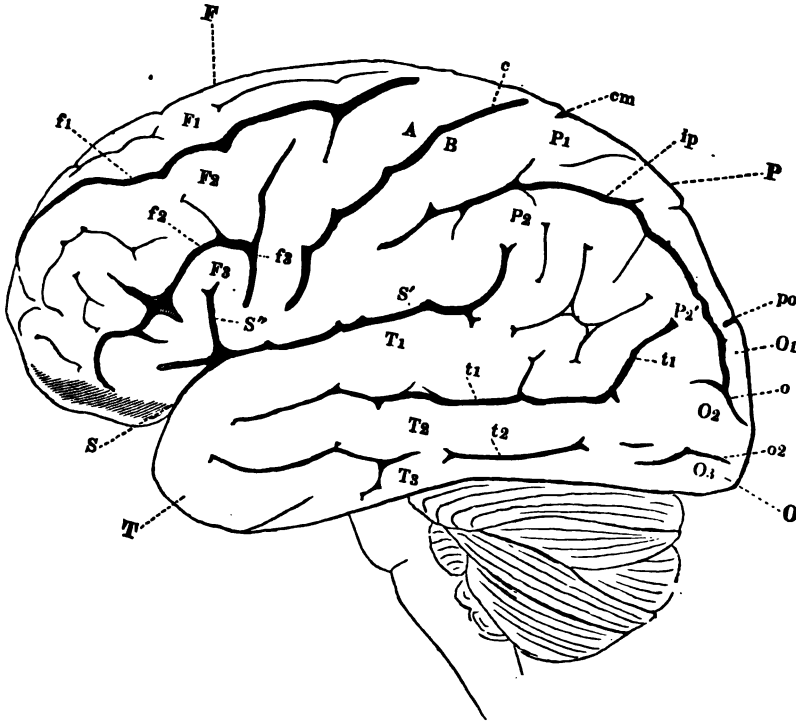


FIG. 1.—LATERAL VIEW OF THE BRAIN. F. Frontal Lobe. P. Parietal Lobe. O. Occipital Lobe. T. Temporo-sphenoidal Lobe. S. Fissure of Sylvius. S' horizontal, S'' ascending ramus of the same. c. Sulcus Centralis. A. Anterior, B. Posterior Central Convolution. F. Superior, F₁ Middle, F₂ Inferior Frontal Convolution. f₁ Superior, f₂ Inferior Frontal Sulcus. f₃ Sulcus Præcentralis. P. Superior Parietal Lobule. P₁ Inferior Parietal Lobule, viz. P₂ Gyrus Supramarginalis, P₃ Gyrus Angularis. ip. Sulcus Interparietalis. cm. Termination of the Calloso-marginal Fissure. O₁ First, O₂ Second, O₃ Third Occipital Convolution. po. Parieto-occipital Fissure. o. Sulcus Occipitalis transversus. o₁ Sulcus Occipitalis longitudinalis inferior. T₁ First, T₂ Second, T₃ Third Temporo-sphenoidal Convolution. t₁ First, t₂ Second Temporo-sphenoidal Fissure.

nexions. As a result of this the individual convolutions of the same run—as Bischoff has correctly stated¹—

¹ *Loc. cit.* s. 37.

almost horizontally; and there is sometimes formed—a fact to which Huschke has 'called attention'—a kind of funnel in the neighbourhood of the frontal tuberosity by the assemblage at this spot of several curves of the gyri of the vertex. Arrived upon the inferior orbital surface, the convolution very soon begins to taper off, to form, after converging with the first and third convolutions, the posterior apex of the triangle which is assumed by the orbital surface of the Frontal Lobe.

Gyrus
frontalis
inferior.

3. *Gyrus Frontalis tertius sive inferior*. 'Dritte oder untere Stirnwindung' (F_3).

Syn. Pli frontal inférieur ou premier, ou étage surcilier. Gratiet.²

Infero-frontal gyrus. Huxley.

This convolution passes from the inferior portion of the anterior Central convolution, forms the superior boundary of the most anterior portion of the horizontal division of the *Fossa Sylvii*, takes a share in the formation of the *Operculum* ('Klappdeckel'), which roofs in the Island of Reil, and then, after curving round the anterior ascending portion of the *Fissura Sylvii* (S''), takes a curve, first anteriorly, and then mesially, toward the posterior apex of the triangular orbital surface of the Frontal Lobe. If, as frequently happens, the anterior ascending ramus of the Sylvian Fissure splits in a radiating fashion into numerous accessory sulci, these latter are also skirted by

¹ *Loc. cit.* s. 140.

² Bischoff (*loc. cit.* s. 38) most certainly with proper right opposes the introduction of the term *Pli surcilier* or orbital convolution (*Augenwindung*) into the anatomical nomenclature of the human brain, where it has neither topographical nor physiological foundation.

the curvature of the convolution in question, and there result therefrom in the course of the same manifold serpentine sinuosities.¹

II. SULCI.

The three Frontal convolutions, which have just been described in detail, are separated from each other, on their upper, or lateral, surfaces by two sulci.

1. *Sulcus Frontalis superior*. 'Obere Stirnfurche' (f_1). Sulcus frontalis superior.
Syn. Supero-frontal sulcus. Huxley.

This divides the upper, or first, Frontal convolution from the second one.

2. *Sulcus Frontalis inferior*. 'Untere Stirnfurche' (f_2). Sulcus frontalis inferior.
Syn. Infero-frontal sulcus. Huxley.
Sulcus frontalis medius. Pansch.²

The development of the above-mentioned fissure is of a very varying character, for it is very frequently bridged over here and there by secondary convolutions, which bring the individual Frontal convolutions into relation with one another.

A third sulcus runs in a direction approaching the perpendicular, consequently at an angle to the preceding. This is the—

¹ This is the well-known convolution, a lesion of which, on the left side, is associated, according to the observations of Broca and others, with either loss or impairment of the faculty of articulate language, without the intellect being involved.

² *Medius*, Pansch calls it, because in the apes there is still another sulcus to be found below it, which runs forward horizontally, but has nothing to do with the question of gyral frontiers.

Sulcus
præcentralis.

3. *Sulcus præcentralis*. 'Senkrechte Stirnfurche' (F_1).¹

Syn. Antero-parietal sulcus. Huxley.

Ramus descendens, of the sulcus frontalis medius. Pansch.²

This tolerably constant fissure aids in forming the anterior boundary of the anterior Central convolution, and mounts upwards between the anterior ascending ramus of the Sylvian Fissure and the lower end of the *Sulcus Centralis* (c). From the *Fissura Sylvii* it is cut off by the origin of the inferior Frontal convolution out of the anterior Central convolution, but at times also it cuts into this. A complete fusion, however, with the Sylvian Fissure has not yet come under my observation. If this come to pass, which, nevertheless, is not frequent, the spot where it happens is always behind the ascending ramus of the Sylvian Fissure.³

This sulcus divides in the course of its ascent—that is to say, it despatches a ramus backwards and upwards, which courses along the anterior Central convolution, and helps to bound it anteriorly. At times, on account of its further prolongation upwards, it cuts off the origin of the middle Frontal gyrus entirely, and that of the upper one partially, from the *Gyrus Centralis anterior*. A second

¹ I prefer this name, for the reason that this sulcus is situated in front of the Central fissure, and in a direction pretty parallel to it, and consequently runs, not horizontally, as do the rest of the Frontal convolutions, but vertically.

² Gratiolet (*loc. cit.* p. 25) has given this sulcus no particular name, but describes it, nevertheless, very accurately in the brain of *Cercopithecus*, and figures it in the human brain.

³ Turner (*loc. cit.* p. 9, and fig. 1) has identified this sulcus—but, in my opinion, incorrectly—with the ascending ramus of the Sylvian Fissure; and regards the separation of the former from this latter by the superficial origin of the most inferior Frontal convolution from the *Gyrus Centralis anterior* as quite exceptional.

ramus passes forward, and effects a junction with the *Sulcus Frontalis inferior* (f_2).¹

I have found this, as a rule, most unmistakably evident in the foetal brain from the sixth month and onwards, and regard it as typical.

On the median surface the upper Frontal convolution is not infrequently divided by a fissure running parallel to the *Sulcus Callosomarginalis* into two convolutions which lie above and parallel to one another. The inferior surface of the Frontal Lobe has, as mentioned above, the form of a triangle, the base of which is directed anteriorly, and is situated in the angle between the *Pars Frontalis* and *Orbitalis* of the frontal bone, while its apex points posteriorly, and answers about to the apex of the pyramid formed by the orbit. One arm of the triangle, the mesial, runs parallel to the median; the other, the lateral, parallel to the lateral wall of the orbit.

The sulci which are to be found on this surface are (see fig. 3)—

4. The *Sulcus olfactorius*. ‘Riechnervenfurche’ (f_4).

*Sulcus
olfactorius.*

This runs parallel to the mesial arm of the triangle just described, and forms the lateral boundary of the continuation of the first Frontal convolution—the *Gyrus rectus* (F_1)—which runs alongside of it. In it the *Tractus olfactorius* is imbedded.

5. *Sulcus Orbitalis* (f_5).

*Sulcus
orbitalis.*

The rest of the sulci upon the inferior surface of the

¹ Huxley (*loc. cit.* p. 257) states that it debouches into the *Supero-frontal sulcus* (*Sulcus Frontalis superior*), a statement which must be due to a *lapsus calami*.

Frontal Lobe are very variable in their shape. There is generally one present which is parallel to the lateral arm of the above-mentioned triangle, and which separates the

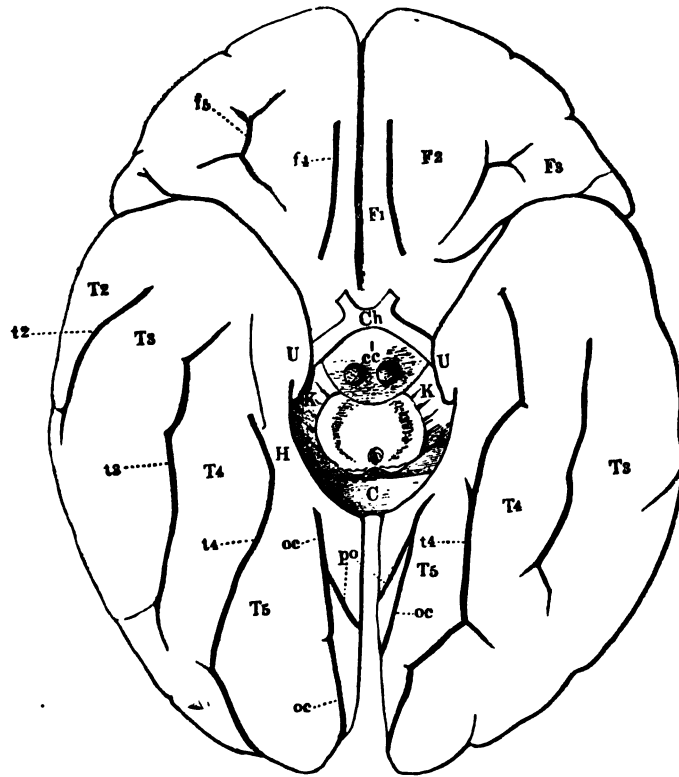


FIG. 3.—VIEW OF THE BRAIN FROM BELOW.—F, Gyrus rectus, F, Middle, F, Inferior Frontal Convolution. f, Sulcus Olfactorius. f, Sulcus Orbitalis. T, Second or Middle, T, Third or Inferior Temporo-sphenoidal Convolution. T, Gyrus Occipito-temporalis lateralis (Lobulus Fusiformis). T, Gyrus Occipito-temporalis medialis (Lobulus Lingualis). t, Sulcus Occipito-temporalis inferior. t, Inferior, t, Middle Temporo-sphenoidal Fissure. po, Parieto-occipital Fissure. oc, Calcarine Fissure. H, Gyrus Hippocampi. U, Gyrus Uncinatus. Ch, Optic Chiasma. cc, Corpora Caudicantia (albicantia). KK, Crura cerebri. C, Corpus Callosum.

second and third Frontal convolutions from one another. This I will call the *Sulcus Orbitalis*. Sometimes there

passes forwards from this sulcus yet another one, from which there results the shape of a triradiate star or of an H, and from which the names *Triradiate sulcus* (Turner)¹ and *Solco crociforme* (Rolando)² derive their origin.

In brains very rich in convolutions,³ the Frontal convolutions are separated by such numerous secondary gyri, while the sulci, on the other hand (*Sulcus frontalis superior, inferior*), which separate them, are bridged over by so large a number of annectent convolutions, that it becomes often a matter of difficulty to distinguish what belongs to one convolution and what to another.⁴

In order to learn to distinguish the Frontal gyri it is necessary to make preliminary examination of either brains poor in convolutions, or those of the newly born, but especially foetal brains of the period of the later months of pregnancy. Here the style of architecture of the human Frontal convolutions is reduced to its simplest expression, and one is enabled to recognise, almost, as it were, in a diagrammatic sketch, all the essentially typical factors, without having the view rendered hazy, and without being diverted from that which is essential by secondary sulci and gyri, which answer, in a certain measure, to a more florid style of decoration.

¹ Turner, *loc. cit.* p. 15. Fig. 3. TR.

² *loc. cit.* p. 32.

³ See the figures in R. Wagner, *loc. cit.*

⁴ Gratiolet (*loc. cit.* p. 9) finds, with regard to the relations of these Frontal convolutions to one another, that in Europeans the inferior Frontal convolution is in most cases isolated, while the middle and upper ones fuse together at many points; but that in the Bushman, on the other hand, the superior convolution remains isolated, while the middle and lower ones frequently fuse together.

Lobus
parietalis.

B. *Lobus Parietalis*. 'Scheitellappen.' P.

On the Parietal Lobe there may be distinguished an upper, and, at the same time, lateral, vaulted surface, which lies in the fossa of the parietal bone, and a plane surface which looks towards the great vertical cerebral fissure. This lobe is, on the superior surface, separated from the Frontal Lobe by the *Sulcus Centralis*, from the Temporal Lobe, for the greater part, at all events, by the *Fissura Sylvii*, and incompletely from the Occipital Lobe by the *Fissura Parieto-occipitalis*.¹ On the median surface, however, the separation from the Occipital Lobe, which is effected by the fissure in question, comes to be a complete one. On this surface there ascends a sulcus (the *Sulcus callosomarginalis* of Huxley) behind the upper end of the posterior Central convolution, towards the median and upper edge of the hemisphere, and so marks out upon this surface, together with the *Fissura Parieto-occipitalis*, the boundaries of a quadrilateral, which has been described as a special lobe by several authors; to wit, by Burdach as the *Præcuneus* ('Vorzwinkel'), and by Foville as the *Lobule quadrilatère*.

SULCI, LOBULES, AND CONVOLUTIONS OF THE PARIETAL LOBE.

Gyrus
centralis
posterior.

1. *Gyrus Centralis posterior*. 'Hintere Centralwindung' (B).

¹ I would fain dispute the statement, which has been asserted, that the *Sulcus Occipitalis*, when it is present, takes a share in forming the boundary. I find that this sulcus invariably runs over the *Cuneus*, and, therefore, over a portion of the Occipital Lobe, but not between this latter and the Parietal Lobe.

Syn. The posterior of the Processi enteroides verticali di mezzo.
 Rolando.
 Circonvolution transverse médio-pariétale. Foville.
 Deuxième pli ascendant. Gratiolet.
 Ascending parietal convolution. Turner.
 Postero-parietal gyrus. Huxley.

From this convolution, which bounds the Central fissure posteriorly, and comes into relation with the anterior Central convolution at the upper and lower ends of the same, the convolutions of the Parietal Lobe pass posteriorly, the grouping of which is first limited by the following sulci :

2. *Sulcus Interparietalis*. 'Scheitelfurche' (*ip*).

Sulcus inter-
 parietalis.

Syn. Sulcus parietalis. Pansch.
 Intra-parietal fissure. Turner.¹

This sulcus, although it exhibits a very constant presence as well in the brain of apes as in that of man, and is but seldom omitted in the numerous figures of the brain just mentioned, has, nevertheless, been described only by Pansch and Turner as an important and typical fissure, and under an especial name.²

This sulcus takes an oblique course from before backwards through the Parietal Lobe, which it divides into two subdivisions—an upper, or mesial, and an inferior, or lateral, Parietal lobule, *Lobulus Parietalis superior et inferior* (*P₁* and *P₂*). The sulcus, which is already recog-

¹ Turner. 'Notes more especially on the Bridging Convolutions, &c.' p. 4.
 'The Convolutions of the Human Cerebrum Topographically Considered,' p. 12.

² Bischoff (*loc. cit.* s. 20) admits, it is true, that this fissure is present and typical in the fœtus, but disputes the importance ascribed by others to its persistence in the adult.

nisable in the brain of a foetus at the sixth month, begins close over the posterior ramus of the Sylvian Fissure, being separated from the latter by the arch-like convolution

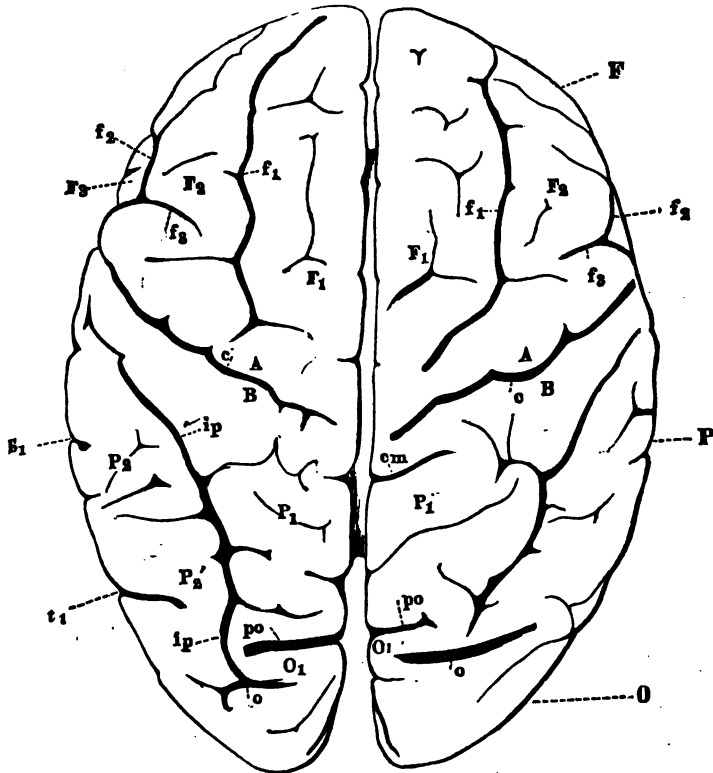


FIG. 2.—VIEW OF THE BRAIN FROM ABOVE. F. Frontal Lobe. P. Parietal Lobe. O. Occipital Lobe. S. End of the horizontal ramus of the Fissure of Sylvius. c. Central Fissure. A. Anterior, B. Posterior Central Convolution. F. Superior, F₁ Middle, F₂ Inferior Frontal Convolution. f. Superior, f₁ Inferior Frontal Sulcus. f₂ Sulcus Præcentralis. P. Superior Parietal Lobule. P₁ Inferior Parietal Lobule, viz., P₂ Gyrus Supramarginalis, P₃ Gyrus Angularis. ip. Interparietal Fissure, cm. Callosal-marginal Fissure. po. Parieto-occipital Fissure. t. Superior Temporo-sphenoidal Fissure. O₁ First Occipital Convolution. o. Sulcus Occipitalis transversus.

which connects the lower extremity of the posterior central convolution (B) with the *Gyrus supramarginalis*.

It then runs behind the posterior Central convolution obliquely upwards, separating by this, its first ascending portion, the convolution just mentioned, from the anterior part of the lower Parietal Lobule—the *Gyrus supra-marginalis*. Next it runs backwards and obliquely in a mesial direction towards the lateral end of the *Fissura Parieto-occipitalis* (*po*), but does not succeed in reaching the latter, being separated from it by the *Gyrus Occipitalis primus* (*o₁*), which runs between the two fissures, from the Parietal to the Occipital Lobe, and then runs posteriorly pretty parallel to the upper and mesial margin of the hemisphere, sooner or later there to terminate. Sometimes its end dips into the transversely-running *Sulcus Occipitalis* (*o*), while sometimes it runs almost to the extremity of the *Lobus Occipitalis*.

Frequently the sulcus is less distinct, being—and this appears to be more frequent on the right than on the left side—bridged over at one spot or the other by a secondary convolution, by which it is completely divided into an anterior and a posterior division. Certain it is, however, that an occurrence of such sort is not more frequent than in other sulci, which are unquestionably allowed on all sides to be typical—*e.g.* the Temporal sulci.

The *Fissura Interparietalis* separates the upper lateral surface of the Parietal Lobe into two divisions; an upper mesial one directed towards the great vertical cerebral fissure, and a lower lateral one, bordering upon the Sylvian Fissure, which we distinguish as the superior and inferior Parietal Lobules respectively.

3. *Lobulus Parietalis superior*, 'Oberes Scheitelläppchen' (*P₁*), and *Præcuneus*, 'Vorzwickel' (*P'₁*).

*Lobulus
parietalis
superior.*

a. Lobulus Parietalis superior.

Syn. Gyrus parietalis superior (exclusive of the hintere Centralwindung). Pansch.

Lobule du deuxième pli ascendant. Gratiolet.

Postero-parietal lobule. Huxley, Turner, and other English authors.

Erste Scheitellappenwindung (Gyrus parietalis superior). R. Wagner.

Oberer Scheitelbeinlappen. Huschke.

Obere innere Scheitelgruppe. Bischoff.

β. Præcuneus, 'Vorzwinkel.' Burdach.

Syn. Lobule quadrilatère. Foville.

Quadrangle lobule. Huxley.

This is brought to pass, as Huschke has correctly described, and according to which Gratiolet has framed his description, by a curving round of the upper end of the posterior Central convolution posteriorly, and by the development of the same into a lobule, consisting of several convolutions, which extends backwards as far as the *Fissura Parieto-occipitalis*, and is brought into relation with the Occipital Lobe through the medium of the *Gyrus Occipitalis primus* (o_1), which courses round the lateral end of the sulcus just mentioned.

In this lobule a superior (lateral) and a median surface may be distinguished, which pass into one another, without any well-defined boundary, on the upper median edges of the hemisphere.

a. On the lateral surface the superior Parietal Lobule is laterally bounded by the *Fissura interparietalis*, passing anteriorly, without any defined boundary, into the posterior Central convolution, while posteriorly it is divided off mesially from the Occipital Lobe by the upper portion of the *Fissura Parieto-occipitalis*, and laterally

passes direct into the same, through the *Gyrus Occipitalis primus*, which courses round the lateral end of the last-named fissure. The median surface is in many directions so strikingly clearly marked out by boundaries that it was one of the first divisions to be properly recognised on the surface of the brain. This is the—

b. *Præcuneus*, 'Vorzwickel.' Burdach.

I shall retain Burdach's terminology for the mesial surface. The *Præcuneus* is distinctly and sharply divided off by the *Fissura Parieto-occipitalis* (*p o*) from the occipital lobe, and, in particular, from the *Cuneus* ('Zwickel') of the same, while anteriorly it is bounded by the vertically rising end of the *Fissura callosomarginalis* (*cm*). This fissure terminates behind the posterior Central convolution by a notch into the mesial edge of the hemisphere, which is distinctly recognisable in the majority of brains, and best actually in the brain of a foetus at from the seventh to the eighth month.¹

Inferiorly, the *Præcuneus* stands in relation, as will be presently more fully described, with the *Gyrus fornicatus* ('Bogenwindung').

4. *Lobulus parietalis inferior*. 'Unteres Scheitelläppchen' (*P₂* and *P₂¹*).

*Lobulus
parietalis
inferior.*

Syn. *Gyrus parietalis inferior*. Pansch.

This is situated beneath and laterally to the *Fissura interparietalis*, and consists of convolutions, sometimes simple, sometimes more or less complex, which, neverthe-

¹ Since the posterior Central convolution likewise pertains to the Parietal Lobe, the anterior frontier of the *Præcuneus*, i.e. of the mesial portion of the Parietal Lobe, is consequently not the same as that of the lateral portion. Here the Parietal Lobe reaches to the Central fissure, there only as far as the posterior edge of the posterior Central convolution.

less, in their principal direction, pass downward archwise round the upper end of the Sylvian Fissure and the *Fissura Temporalis superior* towards the Temporal Lobe. This gyrus undergoes, as a rule, separation into two divisions, an anterior and a posterior one, of which the first encircles the end of the *Fissura Sylvii*, and the second the extremity of the *Fissura Temporalis superior*.

Lobulus
supramargi-
nalis.

A. Anterior Division. *Lobulus supramarginalis* (P_2).¹

Syn. Pli marginal supérieur and Lobule du pli marginal supérieur. Gratiolet.

Dritte Scheitellappenwindung. Gyrus parietalis tertius, *sive* inferior. R. Wagner.

Unterer Zug aus der hintern Centralwindung und Scheitelhöckerläppchen. Lobulus tuberis. Huschke.

Erste oder vordere Scheiteltbogenwindung (No. 11). Bischoff.

This lobule lies betwixt the inferior end of the posterior Central convolution and the upper end of the *Fissura Sylvii*, and rises out of the lower extremity of the former, forming the most posterior portion of the *Operculum*, then becomes developed into a lobule consisting of several gyri, and curves bridgewise around the end of the Sylvian Fissure, to pass, finally, as the superior boundary of this fissure, into the *Gyrus Marginalis inferior sive Temporalis superior* (T_1).

Gyrus
angularis.

B. Posterior Division. *Gyrus Angularis*, Angular Gyrus. Huxley (P^1_2).

Syn. Pli courbe. Gratiolet.

Zweite oder mittlere Scheitellappenwindung. Gyrus parietalis secundus, *sive* medius. R. Wagner.

¹ According to Gratiolet, 'cet lobule est particulier à l'homme, et ne se trouve pas ni dans l'orang ni dans le chimpanzee,' and is, according to Prof. Rolleston, 'very frequently asymmetrical on the two sides of the same brain.' Transl.

Aufsteigende Windung zum hintern äussern Scheitelläppchen und hinteres äusseres Scheitelläppchen. Huschke.
Zweite oder mittlere Scheiteltbogenwindung (No. 12). Bischoff.

This convolution emerges posteriorly from the lobule just described, being bounded superiorly by the *Fissura interparietalis*, and being posteriorly, without any well-defined boundary intervening, in relation with the *Lobus Occipitalis*—that is to say, with the *Gyrus Occipitalis secundus* (O_2), and passes inferiorly, in a curve encircling the upper end of the first Temporal sulcus (t_1), into the middle Temporal convolution, *Gyrus Temporalis medius* (T_2). Occasionally this convolution is brought into relation with the *Lobulus Parietalis superior* by a bridge which crosses the *Fissura interparietalis*.

In brains very rich in convolutions the two gyral tracks just described are extremely complex, and it becomes a matter of difficulty to unravel them. In order to attain to a complete understanding of the convolutions of this region, it is absolutely necessary to have recourse to brains poor in convolutions for reference, and, above all things, the brain of a foetus in one of the later months of embryonic existence.

C. *Lobus Occipitalis*. ‘Hinterhauptlappen.’ Occipita
lobe.
(Q.)

The Occipital Lobe is in man but small in comparison with the rest of the hemisphere. It forms the posterior extremity of the latter, filling the upper fossa of the *squama occipitalis*, and resting upon the *tentorium*. Upon it there may be distinguished three surfaces—a median, abutting upon the *corpus callosum*, a lateral (or

upper), and an inferior surface which lies upon the *tentorium*, all of which three fuse together at the posterior extremity of the hemisphere. Of these surfaces the median is flat, the superior vaulted, and the inferior slightly concave.

The anterior line of frontier of the Occipital Lobe, between the latter and the lobe which abuts upon it, is, with the exception of a few spots, somewhat ill-defined.

It is on the median surface that the line of boundary is most distinctly drawn. For here the *Fissura Parieto-occipitalis* (*po*) divides off by its median portion the *Lobus Occipitalis*—specifically the *Cuneus*—very sharply from the Parietal Lobe—in particular the *Præcuneus*.

Upon the upper surface—because the fissure just described extends itself also over this surface, such separation is likewise defined: nevertheless, since the fissure is sometimes longer, and sometimes shorter, this takes place in a very varying degree. From where this fissure terminates upon the superior surface of the hemisphere, the anterior boundary of the *Lobus Occipitalis* is ill-defined, and it passes laterally from this spot, without a definite frontier-line, into the *Lobus Parietalis* as well as into the *Lobus Temporalis*, through the medium of a number of gyri which have a varying amount of development in various cases.¹ The more this is the case, the more will the above-mentioned fissure be driven backwards towards the median edge of the hemisphere, and the more ill-defined will the anterior boundary of the Occipital Lobe become.

¹ These are the gyri to be considered more in detail presently, which have been described by Gratiolet as 'plis de passage' (Uebergangswindungen) in the brain of the ape.

On the inferior or tentorial aspect there are nowhere throughout frontiers between the Occipital and the Temporal Lobes; and it is only in quite fresh brains, or

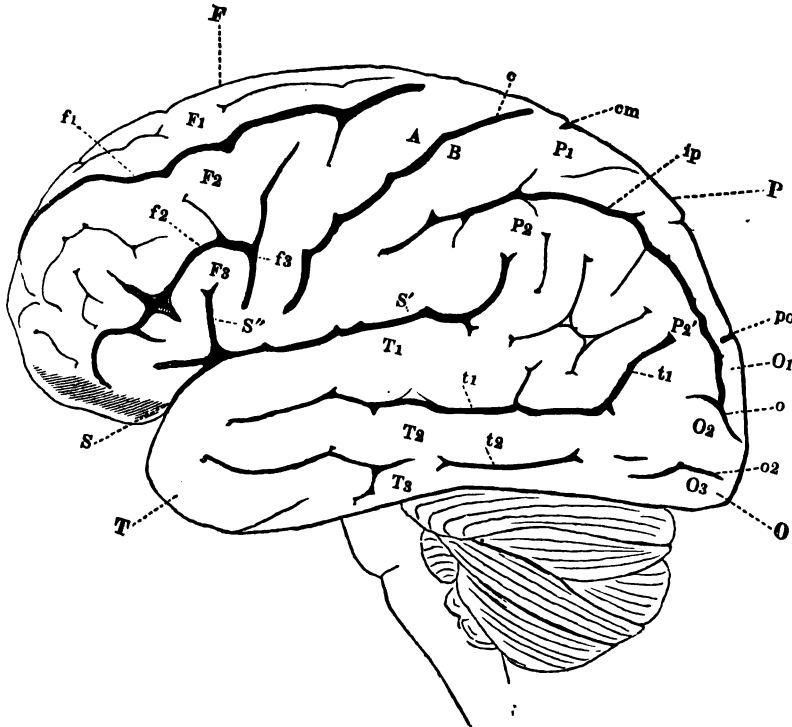


FIG. 1.—LATERAL VIEW OF THE BRAIN. F, Frontal Lobe. P, Parietal Lobe. O, Occipital Lobe. T, Temporo-Sphenoidal Lobe. S, Fissure of Sylvius. S', horizontal, S'', ascending ramus of the same. c, Sulcus Centralis. A, Anterior, B, Posterior Central Convolution. F₁, Superior, F₂, Middle, F₃, Inferior Frontal Convolution. f₁, Superior, f₂, Inferior Frontal Sulcus. f₃, Sulcus Præcentralis. P₁, Superior Parietal Lobule. P₂, Inferior Parietal Lobule, viz., P₂, Gyrus Supramarginalis, P₃, Gyrus Angularis. ip, Sulcus Interparietalis. cm, Termination of the Callosal-marginal Fissure. O₁, First, O₂, Second, O₃, Third, Occipital Convolution. po, Parieto-occipital Fissure. o, Sulcus Occipitalis transversus. o₁, Sulcus Occipitalis longitudinalis inferior. T₁, First, T₂, Second, T₃, Third Temporo-Sphenoidal Convolution. t₁, First, t₂, Second, Temporo-Sphenoidal Fissure.

in such as have been hardened inside the cranial cavity, that there comes into view a shallow transverse sulcus

which approximately indicates the limits of the two divisions, and which results from an impression made by the upper edge of the petrous bone, but disappears, as a rule, after the removal of the brain from the cranial cavity.¹

SULCI, DIVISIONS, AND GYRI OF THE OCCIPITAL LOBE.

Sulcus
occipitalis
transversus.

1. *Sulcus Occipitalis Transversus*. 'Hintere oder quere Hinterhauptsfurche' (o).

Syn. Fissura occipitalis externa. Pansch.

Fissura occipitalis perpendicularis externa. Bischoff.

Over the superior surface of the Occipital Lobe, that is to say, over the base of the triangular lobule which is distinguished by the name of *Cuneus* ('Zwickel'), there runs a transverse fissure which I propose to call by the above-mentioned name. This is, to be sure, sometimes absent, or has no considerable degree of development, but appears, nevertheless, to possess a certain morphological significance. In those cases in which it is properly developed, there will be found at a certain distance behind the *Fissura Parieto-occipitalis* a transverse sulcus, which is often somewhat deeply sunken, and into which the *Fissura interparietalis* very frequently debouches anteriorly. Around the median extremity of the same there runs an arch-like gyrus, which is a direct prolongation of the one which has coursed round the lateral end of the *Fissura Parieto-occipitalis*—this is the *Gyrus Occipitalis primus* (O_1) presently to be described. In some cases I have seen the posterior edge of the fissure so

¹ Compare Krause, *Handbuch der Anatomie*. Hannover, 1838. I. 3, s. 853. Bischoff, *loc. cit.*, s. 29.

bevelled off that it lay like a lid upon the anterior edge of the same—a relation which forcibly reminds one of the *Operculum* of the brain of the ape. In the foetus this fissure is clearly recognisable at a pretty early period, as Bischoff has stated,¹ but in the statement that it regularly disappears again at the eighth month—as this observer asserts²—after what has been just said, I can in no way concur.

2. *Fissura Calcarina*. Huxley (o c).

*Fissura
calcarina*

Syn. Scissure des Hippocampes (posterior portion). Gratiolet.

Fissura horizontalis. Pansch.

Fissura posterior, sive occipitalis horizontalis. R. Wagner.

Fissura Hippocampi. Bischoff.

This very constant fissure—one which, together with the Parieto-occipital Fissure, is the first of all others to make its appearance in the brain of the foetus, and is completely developed at a very early period—begins at the median surface of the hinder end of the hemisphere in two crura, which diverge posteriorly forkwise in directions upwards and downwards, and running forwards from there, fuses at an acute angle with the Parieto-occipital Fissure. From here onwards a fissure extends itself to beneath the hinder extremity of the corpus callosum, as a common prolongation of the two sulci. Here the *Gyrus Fornicatus* bounds it, and cuts it off from the *Fissura Hippocampi* (*h*). The sulcus is very deep, and upon its development depends—as has been proved by transverse sections—the size of the prominence in the lateral ventricle which goes

¹ *loc. cit.*, s. 58. Tab. iv., figs. 7—9. C'.

² *loc. cit.*, s. 60.

by the name of the *Calcar avis* or *Pes Hippocampi minor*. Hence the name which Huxley has given to it.

3. *Sulcus Occipito-Temporalis Inferior*.

I will pass over the consideration of this, a sulcus which is situated upon the inferior surface of the Occipital Lobe, because it pertains equally to the temporal lobe, and will, therefore, as a matter of course, receive due notice further on in the description of the inferior surfaces of the two lobes from which it derives its name.

Divisions of
occipital
lobe.

The Divisions of the *Lobus Occipitalis*.

a. Such differentiation can only be made with distinctness upon the median surface of the lobe. Here may be distinguished—

Cuneus.

1. The *Cuneus* (Burdach) 'Zwickel' (O_z).

Syn. Lobule occipital. Gratiolet.

Internal Occipital Lobule. Huxley.

Gyrus Occipitalis Primus. Erste obere Hinterhauptlappenwindung. Wagner.

Oberer Zwischenscheitelbeinlappen. Huschke.

Since the *Fissura Calcarina* fuses upon this surface with the *Fissura Parieto-occipitalis*, a triangular, wedge-shaped piece comes to be cut off from the anterior portion of the *Lobus Occipitalis*, the base of which looks superiorly and posteriorly, while its apex is directed inferiorly and anteriorly. This is the *Cuneus*.

2. There can further be distinguished upon the median surface, and, at the same time, at the hinder extremity of the hemisphere, a small lobule, which goes to form the posterior extreme point of the hemisphere, and is situated behind the diverging rami of the *Fissura*

Calcarina. To this I will give the name of *Lobulus Extremus* ('Endläppchen').

3. Whatever lies beneath the Calcarine fissure pertains already to the inferior surface of the *Lobus Occipitalis*, the convolutions of which pass over into those of the inferior surface of the Temporal Lobe, without the intervention of any definite frontier line, and, on such account, had better be considered, in common with the latter, in a special and separate section.

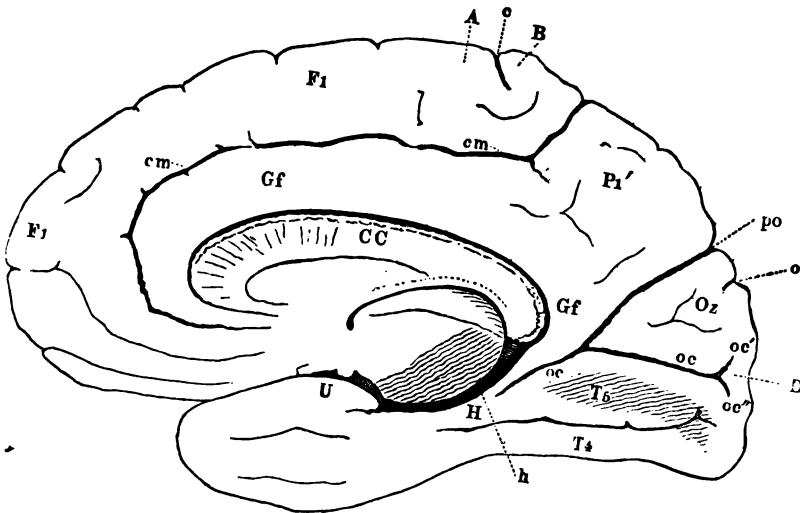


FIG. 4.—VIEW OF THE RIGHT HEMISPHERE ON THE MEDIAN ASPECT.—CC Corpus Callosum, longitudinally divided. Gf Gyrus Fornicatus. H Gyrus Hippocampi. h Sulcus Hippocampi. U Uncinate Gyrus. cm Sulcus Callosus-marginalis. F1, median aspect of First Frontal Convolution. c Terminal portion of the Sulcus Centralis. A Anterior, B Posterior Central Convolution. P' Præcuneus. Oz Cuneus. po Parieto-Occipital Fissure. o Sulcus Occipitalis transversus. oc Calcarine Fissure. oc' Superior, oc'' Inferior ramus of the same. D Gyrus Descendens. Tl, Gyrus Occipito-temporalis lateralis (Lobulus Fusiformis). Tm, Gyrus Occipito-temporalis medialis (Lobulus Lingualis).

4. On the upper and lateral surfaces likewise no definite sub-division into lobules is seen to take place. Only, should the *Sulcus Occipitalis transversus* (O) be distinctly

developed, will the upper surface of the Occipital Lobe appear divided into an anterior and a posterior section. It may, nevertheless, not be out of place to recapitulate here the remark that such a differentiation in no wise corresponds to that on the median aspect, and cuts off neither the *Præcuneus* (Parietal Lobe) from the *Cuneus*, nor this latter from the convolutions upon the inferior surface; for the *Sulcus Occipitalis transversus* runs rather transversely over the upper surface basis of the *Cuneus* itself.

Convolutions of occipital lobe.

THE CONVOLUTIONS OF THE OCCIPITAL LOBE.

It is certainly subject to no doubt that the comprehension of the convolutions of the *lobus occipitalis* is in itself more difficult than that of all the other lobes. Nevertheless, I think I err not in asserting that the difficulties which arise out of the nature of the subject—that is, in particular, the great individual variability of the convolutions of this territory—have been still materially augmented by the circumstance that men have transferred—not, however, without doing some violence to nature—the nomenclature of the brain of the ape without more ado to the brain of man. In no part of the brain's superficies is the difference between the brains of those apes from which Gratiolet's description has been derived (*Cercopithecus*, &c.), and that of man greater than just in the Occipital Lobe. For in the apes which are classed under the genera *Cercopithecus*, *Inuus*, *Cynocephalus*, *Cebus*, &c., the Occipital Lobe is divided off upon its upper surface from the Temporal Lobe by a deep transverse indentation; and the posterior margin of this fissure (*Scissure perpendiculaire*. Gratiolet)—in other words, the anterior edge of the occipital lobe—is bevelled off, and

overtops this fissure like a penthouse, which name (*Operculum*), moreover, it bears. Screened by this penthouse, and, therefore, sunk in the depth of the fissure, there pass certain convolutions from the upper and lower Parietal Lobules to the Occipital Lobe. These convolutions, placed in ambush, as it were—there are two of them—which, of course, on account of their concealed position, are quite peculiar, Gratiolet thought necessary to designate with a special name, and called them, accordingly, *Plis de passage*—Bridging convolutions (*Uebergangswindungen*). He has, moreover, conferred this title upon yet two other convolutions, which likewise lie upon the upper surface, but laterally to the preceding, and which connect the Temporal with the Occipital Lobe. These two last-mentioned convolutions are, however, in the apes just instanced, never concealed, but lie quite superficially. Finally, Gratiolet has described as bridging convolutions two gyri yet—likewise superficial—of the median surface, which connect the Temporal with the Occipital Lobe—to speak more in detail, the *Præcuneus* with the *Cuneus*. These he calls the ‘internal’ bridging convolutions,¹ and distinguishes them as superior and inferior; while those first-named he terms ‘external,’ and distinguishes them serially, from the median margin of the hemisphere laterally, as the first, second, third, and fourth external bridging convolutions. There are then in these apes only the first and second external bridging convolutions which offer any peculiarity, and deserve, in some sort, a special designation; while, as for the rest, they have, in reality, in no wise anything to distinguish them above the other convolutions which connect the various lobes with

¹ For a description of these, see the convolutions of the median surface.

one another, and one might, with equal right, reckon those convolutions, for example, which on the lower surface connect the *Lobus Occipitalis* and *Temporalis*, also under the category of bridging convolutions. In numerous higher apes, however, the *Operculum* is entirely wanting, and with its disappearance vanishes also the single peculiarity which has distinguished these convolutions. These, then, are superficial convolutions just as much as are the rest.

So is it too in the case of man. Neither in fully developed brains, nor at any period whatever of foetal existence, do these convolutions display any peculiarity which would justify any such special—one at least seemingly conveying the idea of something quite special—designation as ‘Bridging convolutions.’ For at no period do they lie peculiarly latent. The two concealed convolutions, and the *Operculum* associated with them, are then in fact a specialty of lower simian forms; their absence being the more decided in man in that they have already made their disappearance in the higher apes. It must of necessity lead to false issues, if in the anatomy of the human brain a terminology be retained which, however well it may suit that of the lower apes, has lost all significance when applied to the brain of man. That the gyral type of the human brain is, as a whole, but a higher development of that of the ape—be this taken in the sense of the Evolution theory or merely in its old-fashioned signification—remains for all this a reality.

In order to obtain a clear picture—dimmed by no preconceived notions—it is before all things necessary to examine numerous brains of embryos in the later months—the seventh, eighth, ninth, or tenth lunar month—of

pregnancy. Here the architectural style of the human brain will be found reduced to its simplest expression, and rendered easy of recognition, while frequently at a later period it becomes no longer so easy a task to sift the essential from that which is accessory. The convolutions of the *Lobus Occipitalis* run out in general from the posterior extremity of the hemisphere upon the upper (and simultaneously the lateral), the median, and inferior surfaces, and diverging—on account of the growth in thickness of the hemisphere—anteriorly, pass over into the Parietal and Temporal Lobes. Between the convolutions of the Occipital Lobe on the one side, and those of the Temporal and Parietal Lobes on the other, upon the upper and mesial surfaces, still to adopt special intermediate factors under the name of ‘Bridging convolutions’ has—as has been mentioned above—in the case of man nothing for its justification, and aggravates in the highest degree the difficulty of a correct appreciation of them. For this reason I have suppressed this term entirely.

The convolutions which I recognise in the *Lobus Occipitalis* are then the following :—

I. UPON THE UPPER SURFACE.

1. *Gyrus Occipitalis primus*, sive *Parieto-occipitalis medialis*. ‘Erste oder obere Hinterhauptwindung’ (O_1). Gyrus occipitalis primus.

Syn. Oberer Zug der hintern Centralwindung (in part).

Huschke.

Erste obere Hinterlappenwindung. Wagner.

Pli de passage supérieur externe and Pli occipital supérieur.

Gratiolet.

First external annectent gyrus. Huxley.

First bridging, annectent, or connecting gyrus. Turner.

Oberer innere (4) Scheitelbogenwindung (No. 14). Bischoff.

Huschke has already described¹ a convolution which,

¹ *loc. cit.*, s. 141.

after passing out from the posterior Central convolution along the median fissure to the hinder extremity of the brain, passes over from thence to the inferior surface. This convolution brings the upper Parietal Lobule into relation with the *Lobus Occipitalis*, and makes up the upper median portion of the latter, whereby the designation which I have given to it is fully justified. Gratiolet has divided—resting upon a peculiarity of a portion of its homologue in certain apes—this convolution into two parts—*Pli de passage supérieur externe*,¹ and *Pli occipital supérieur*; a division which, as has been already stated above, has, in the case of man, no plea of justification. The convolution in question proceeds from the posterior and median extremity of the upper Parietal Lobule, then encircles the lateral upper end of the *Fissura Parieto-occipitalis* (*po*)—which parts the *Lobus Occipitalis* (*O*) from the Parietal Lobule (*P*)—in a sometimes smaller, sometimes larger loop, having its convexity outwards, and passes into the *Cuneus*, upon the upper surface of which it embraces in a second loop, with its convexity mesially directed, the median extremity of the *Sulcus Occipitalis transversus* (*o*) when the latter happens to be present.

Gyrus
occipitalis
secundus.

2. *Gyrus Occipitalis secundus*, sive *Parieto-occipitalis lateralis*. ‘Zweite oder mittlere Hinterhauptwindung’ (*O*₂).

Syn. Pli occipital moyen, and Deuxième pli de passage externe. Gratiolet.

Zweite mittlere Hinterlappenwindung. Wagner.

Gyrus occipitalis medius. Pansch.

Medio-occipital, and second external annectent gyrus. Huxley.

¹ This ‘bridges the chasm,’ says Prof. Rolleston, ‘in Man, in the Orang, and in the *Ateles*, but in no other Ape.’ Transl.

This convolution, which is situated behind the *Sulcus Occipitalis transversus* (*o*), and laterally to the *Fissura interparietalis*, runs forwards from the posterior extremity of the hemisphere to the inferior Parietal Lobule, and passes specially into the *Gyrus angularis* (*P*₂), being divided off from the preceding by the *Fissura interparietalis*.

3. *Gyrus Occipitalis tertius*, sive *Temporo-occipitalis*. Gyrus
occipitalis
tertius.
‘Dritte oder untere Hinterhauptwindung’ (*O*₃).

Syn. Pli occipital inférieur, and Troisième et quatrième pli de passage externe. Gratiolet.

Dritte untere Hinterlappenwindung. Wagner.

Gyrus occipitalis inferior. Pansch.

This convolution likewise runs from the posterior end of the hemisphere, and beneath the preceding, down to the third Temporal Convolution, and to the second one.

All these three convolutions just mentioned proceed from that portion of the Occipital Lobe which is partitioned off on the median surface or *Cuneus*, and, therefore, beneath the *Fissura Calcarina*; consequently, upon the inferior aspect of the Occipital Lobe, two further convolutions may be distinguished. These are as follow:—

4, 5. The *Gyri Occipito-temporales inferiores*.

In order to avoid unnecessary repetition, I will put off more detailed description of these convolutions—which pertain to the Occipital and Temporal Lobes in common—to the description of the latter.

Gyrus
descendens.

6. *Gyrus Descendens* (D, fig. 4).

The superior (mentioned under 1, 2, 3) and the inferior (mentioned under 4, 5) Occipital convolutions are, at the posterior extremity of the hemisphere, brought into relation through one or more convolutions which, winding loopwise round the bifurcation of the *Fissura Calcarina*, and entering into the formation of the Terminal Lobule, descend, and are prolonged into the *Lobulus fusiformis* and *lingualis* (T_4 and T_5).¹ Huschke has already stated² that the *Cuneus* parts asunder at its base V-wise into two rami, of which the anterior bends round into the *Præcuneus*, while the posterior goes to form in its descent the tip of the hemisphere, and is again folded upon itself high up, so that here two slender gyri lie concentrically one within the other. Thereupon this branch runs straight forward upon the surface, close to the *Cuneus*, as a fusiform marginal convolution ['Randwulst']. Bischoff, too [*loc. cit.* s. 50], has made mention of this convolution.

7. *Sulci occipitales longitudinales, sive sagittales*. 'Die Längsfurchen des Hinterhauptlappens.'

That which finally concerns the longitudinal sulci of the Occipital Lobe, by which the above described longitudinal convolutions of the upper and lateral surfaces are separated off from one another—these have, with the exception of the first, a very variable development. If these convolutions, as sometimes happens, attain the

¹ Sometimes it is possible to distinguish two such *gyri descendentes* (*medialis* and *lateralis*), of which the first terminates in the *lobus lingualis*, the latter in the *lobus fusiformis*.

² *loc. cit.*, s. 143, 144.

Lobulus extremus, without any notable interruption by a *Sulcus Occipitalis transversus* converging towards the end of the lobe, then will these longitudinal—or sagittal furrows, *Sulci Occipitales longitudinales*, as I will designate them in contradistinction to the *Sulcus Occipitalis transversus*, be, as might be expected, the best defined. One can then with ease distinguish (see fig. 1)—

1. A *Sulcus Occipitalis superior* (O_1), which divides off the *Gyrus Occipitalis primus* from the *Gyrus Occipitalis secundus*, and is none other than a continuation of the *Sulcus interparietalis*.¹ Sulcus occipitalis superior.
2. A *Sulcus Occipitalis inferior* (O_2), which separates the second from the third occipital convolution. Sulcus occipitalis inferior.

One can then distinguish in all five gyri of the Occipital Lobe which run in a 'sagittal' direction—three upon the upper and lateral aspects (described above as the *Gyri Occipitales, primus, secundus*, and *tertius*) and two upon the inferior surface (the *Gyri occipito-temporales*, to be described in detail further on). Of the three first-mentioned the uppermost stands exclusively in connexion with the *Lobulus Parietalis superior*, the second with the inferior Parietal Lobule and the second Temporal Convolution, the third with the latter and the third Temporal Convolution, while the fourth and fifth pertain in common to the Occipital and Temporal Lobes. (These are indicated by the letters T_4 and T_5 in the figures.)

¹ In the fetus the two portions of the *Sulcus interparietalis*—the posterior (*Sulcus occipitalis superior*) and the anterior (*Sulcus interparietalis*)—exist separate from one another, and only at a later period become fused together.

REMARK.—We have made a distinction above (see p. 13) between a *Fissura Parieto-occipitalis* (po), which separates the Occipital from

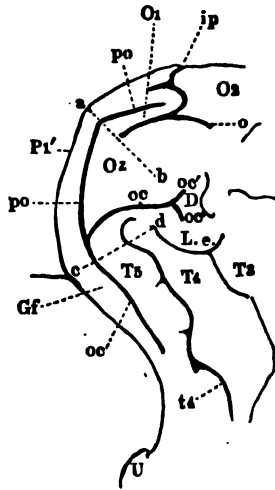


FIG. 5.—THE CONVOLUTIONS OF THE POSTERIOR EXTREMITY OF A HEMISPHERE SURVEYED FROM BEHIND, FROM THE INNER SIDE, AND FROM BELOW, AND PROJECTED UPON A LEVEL. L.e. Lobulus Extremus. Oz. Cuneus. P',. Præcuneus. po. Parieto-occipital Fissure. ip. Interparietal Fissure. o. Sulcus occipitalis transversus. oc. Calcarine Fissure. oc'. Superior, oc'', Inferior ramus of division of the same. t., Sulcus Occipito-temporalis inferior. O₁, Gyrus Occipitalis primus. O₂, Gyrus Occipitalis secundus. D. Gyrus Descendens. G.f. Gyrus Fornicatus. U. Gyrus Uncinatus. T, Lobulus Lingualis. T₄, Lobulus Fusiformis. T₅, Gyrus Temporalis inferior. The dotted line a b indicates the boundary between the upper and median aspects, the line c d that between the median and inferior surfaces.

the Parietal Lobe, and (see p. 36) a *Sulcus Occipitalis transversus* (o) which runs transversely over the upper surface of the former. If we look for the homologues of these fissures among the apes, we shall find among those genera which are characterized by an *Operculum* apparently only one of these fissures—the *Fissura Occipitalis transversa* (*Scissure perpendiculaire*)—to be present. Let us suppose, however, that in the human brain the *Gyrus Occipitalis primus* (O₁) which encircles the lateral end of the *Fissura Parieto-Occipitalis*, and lies quite superficial, has become deeply depressed—right to the *Sulcus Occipitalis transversus*—and that the edges of the transverse fissure which has been brought about by the above depression have become approximated together, in such wise that the posterior margin of the fissure (that is to say, of the *Sulcus Occipitalis transversus*) comes to project pent-house-like over the same, then shall we obtain the picture such as is presented to us by those simian brains which possess an *Operculum*. Externally there is only a fissure to be seen, the posterior margin of which goes to form the *Operculum*. It is at the bottom of this fissure that one first sees, surrounded by the hidden *Gyrus Occipitalis primus* (the first external bridging convolution), the *Fissura Parieto-occipitalis*. Conversely, if we suppose in the brain of some ape, for instance, of a *Cercopithecus*, the convolution in question to be forced up to the

surface, we shall have the above-mentioned transverse depression completely filled up, and there will be distinguishable two transverse fissures; anteriorly, the *Fissura Parieto-occipitalis* girt laterally by the *Gyrus Occipitalis primus*; and, further posteriorly, the *Sulcus Occipitalis transversus*, the mesial extremity of which the same convolution likewise encircles. The *Operculum* simultaneously vanishes with the great fissure, and the Occipital Lobe appears to be much reduced in size. On this point see in particular Pansch, *loc. cit.* p. 25.

D. Temporal Lobe. *Lobus temporalis* ('Schläfenlappen')
or Temporo-sphenoidal Lobe. *Lobus Temporo-*
sphenoidalis ('Schläfenkeilbeinlappen').

Temporo-
sphenoidal
lobe.

The Temporal Lobe, filling up, as it does, the middle fossa of the skull on either side, lies consequently at a deeper level than the Frontal and Occipital Lobes, and goes to form altogether the most deep-lying portion of the cerebrum, so that its apex lies at about the same level as the base of the orbit. Its shape corresponds with that of the middle cranial fossa, being cylindrical on section, and but two surfaces can be distinguished upon it—a lateral and an inferior one, which pass into one another through rounded margins.

The Temporal Lobe is, of all the lobes, the most distinctly circumscribed, being in especial most completely cut off from the Frontal Lobe and from the anterior portion of the Parietal Lobe by the Fissure of Sylvius; while, on the other hand, the frontier-line which divides it off from the posterior portion of the last-named lobe and from the Occipital Lobe is but ill-defined. This holds good particularly for the inferior aspect, upon which the convolutions of the last-named lobe fuse, without the intervention of any distinct frontier-line, with those of the Temporal Lobe, so that it becomes by far the best

course, in order to avoid useless recapitulation, to regard the two lobes just mentioned together as the inferior Occipito-temporal aspect. The fact that a brain quite fresh, or one hardened while still in the cranial cavity, gives evidence at the boundary-line of the two convolutions, in the shape of a shallow impression, of pressure exercised by the upper edge of the petrous bone, which, however, exercises not the smallest influence upon the convolutions, has been already made mention of in a preceding page (p. 36).

Sulci and gyri of temporo-sphenoidal lobe. Sulcus temporalis superior.

THE SULCI AND GYRI OF THE TEMPORAL LOBE. SULCI.

1. *Sulcus Temporalis superior*. Superior Temporo-sphenoidal Fissure (t_1).

Syn. Scissure parallèle (Parallelfurche). Gratiolet.
Antero-temporal Sulcus. Huxley.

This, the most constant of the fissures of the Temporal Lobe, runs parallel to the *Fossa Sylvii*—hence the name given to it by Gratiolet—and cuts off the upper Temporo-sphenoidal convolution, which forms the inferior boundary of the Fissure of Sylvius. Posteriorly and externally it has in various cases a variable extent in width. Its posterior extremity is situated, as a rule, at a higher level than that of the Sylvian Fissure, and in any case there winds round it the convolution which has been previously described (p. 33) as *Gyrus angularis*, and which is continued into the second Temporo-sphenoidal convolution.

The two following sulci are both more variable and of very unequal development, being frequently interrupted and bridged over, and being but seldom both simultaneously distinctly developed. They are—

2. The *Sulcus Temporalis medius*. The Middle Temporo-sphenoidal Fissure (t_2). Sulcus temporalis medius.

Syn. Postero-temporal sulcus. Huxley.

3. The *Sulcus Temporalis inferior*. The Inferior Temporo-sphenoidal Fissure (t_3). Sulcus temporalis inferior.

These run parallel to the upper Temporo-sphenoidal fissure, the middle one still lying entirely upon the lateral aspect of the Temporal Lobe, and not turning on to the inferior aspect of the same till at its anterior inferior extremity, while the inferior sulcus, on the contrary, comes, for the most part, to lie upon the inferior surface.

On to the inferior aspect, then, there follows a sulcus—which pertains as well to the Temporal as to the Occipital Lobe.

4. *Sulcus Occipito-temporalis inferior*. The Inner Inferior Longitudinal Fissure (t_4). Sulcus occipito-temporalis inferior.

Syn. Sulcus longitudinalis inferior. Huschke.

Sulcus occipito-temporalis. Pansch.

Fissura collateralis. Huxley.

Fissura collateralis sive temporalis inferior. Bischoff.

This sulcus courses along the inferior surface of the Occipital and of the Temporal Lobes, taking origin somewhat laterally to the posterior extremity of the former. In its course in a forward direction it separates the *Gyrus Hippocampi* and the *Gyrus Occipito-temporalis medialis* (T_5), which lie to the mesial side of it, from the *Gyrus Occipito-temporalis lateralis* (T_4) which forms its lateral boundary. In its longitudinal extension anteriorly it is subject to considerable variation, at times stretching to the anterior extremity of the Temporal Lobe, thus very

completely circumscribing the *Gyrus Hippocampi* (*vide* Fig. 3, right side of the figure), while at times it breaks

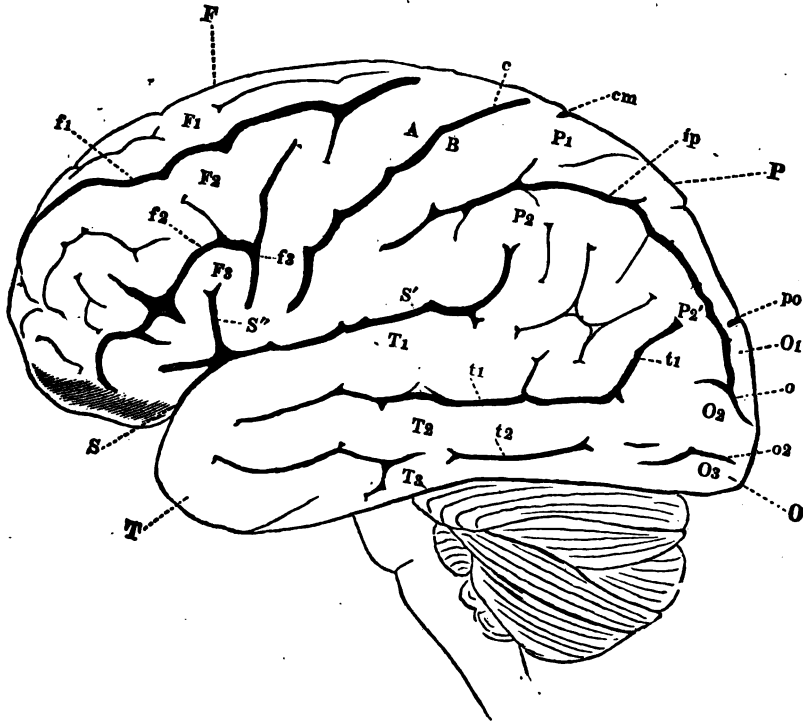


FIG. 1.—LATERAL VIEW OF THE BRAIN. F. Frontal Lobe. P. Parietal Lobe. O. Occipital Lobe. T. Temporo-sphenoidal Lobe. S. Fissure of Sylvius. S' Horizontal, S'' ascending ramus of the same. c. Sulcus centralis. A. Anterior, B. Posterior Central Convolution. F. Superior, F₁ Middle, F₂ Inferior Frontal Convolution. f₁ Superior, f₂ Inferior Frontal Sulcus. f₃ Sulcus precentralis. P. Superior Parietal Lobule. P₁ Inferior Parietal Lobule, viz., P₁ Gyrus supramarginalis, P₂ Gyrus angularis. ip. Sulcus interparietalis. cm. Termination of the Callosal-marginal Fissure. O₁ First, O₂ Second, O₃ Third Occipital Convolution. po. Parieto-occipital Fissure. o. Sulcus occipitalis transversus. o₁ Sulcus occipitalis longitudinalis inferior. T₁ First, T₂ Second, T₃ Third Temporo-sphenoidal Convolution. t₁ First, t₂ Second Temporo-sphenoidal Fissure.

off short as soon as it attains the neighbourhood of the *Fasciculus uncinatus* ('Haken'¹), or else has its conti-

¹ Also *Convolution de crochet*.

nunity interrupted by the bridging over it of a secondary convolution.

This fissure is, as a rule, deep, and sometimes, it seems, so much so that the wall of the lateral ventricle is pressed laterally inward from the *Cornu Ammonis*.¹ It has been termed by Huxley *Fissura collateralis*, for the very reason that it stands to the *Eminentia lateralis* sive *collateralis Meckelii* in a similar relation as the *Fissura calcarina* does to the *Calcar avis*² and the *Fissura hippocampi* to the *Cornu Ammonis*. In other words, it forms a depression which internally has the appearance of a prominence.³

CONVOLUTIONS.

The completeness in structure of the convolutions depends, as a matter of course, entirely upon the degree of development of the sulci, so that in the department of the Temporal Lobe, in which are the most variable sulci, the most varying convolutions must be expected. We may distinguish—

1. The *Gyrus Temporalis superior* (Huschke) sive *inframarginalis*. The Upper Temporo-sphenoidal Convolution (T₁). Gyrus temporalis superior.

Syn. Gyrus temporalis primus. Erste obere Schläfenwindung. Wagner.

¹ A synonym of the *Hippocampus major*. Transl.

² A word synonymous with the *Hippocampus minor*. Transl.

³ It seems to me that the term *Fissura collateralis*, however much it may have the merit of brevity, is not to be commended, since the *Eminentia collateralis Meckelii*, after which model it has been formed, is by no means a constant quantity in the human brain (compare especially Jung 'Ueber die seitliche Erhabenheit im Lateral-Ventrikel des menschlichen Gehirns.' Basel. and Arnold, *Anatomie*, ii., 2, 769), while the *Fissura collateralis* of Huxley comes under the category of the typical, ever present, sulci.

Antero-temporal gyrus. Huxley.

Pli temporal supérieur, or Pli marginal postérieur (inférieur).
Gratiolet.

This extremely constant convolution lies between the Sylvian fissure and the *Sulcus Temporalis superior*, and runs upward, loopwise, around the upper end of the *Fossa Sylvii* over into the *Lobulus supramarginalis*.

Gyrus
temporalis
medius.

2. The *Gyrus Temporalis medius*. Middle Temporo-sphenoidal Convolution (T_2).

Syn. Gyrus temporalis secundus. Zweite oder mittlere Schläfenwindung. Wagner.

Mittlere Schläfenwindung. Huschke.

Pli temporal moyen, and Partie descendante du pli courbe. Gratiolet.

Medio-temporal gyrus. Huxley.

This convolution is—seeing that the superior Temporal Sulcus is scarcely ever wanting—generally distinctly circumscribed. Thus it is plainly differentiable posteriorly and superiorly through its transition into the *Gyrus angularis*, while inferiorly, on the other hand, it is in no way always to be separable from the third convolution for the whole of its length, but frequently fuses with it for a greater or less extent.

Gyrus
temporalis
inferior.

3. The *Gyrus Temporalis inferior*. Inferior Temporo-sphenoidal Convolution (T_3).

Syn. Gyrus temporalis tertius sive inferior. Dritte oder untere Schläfenlappenwindung. R. Wagner.

UPON THE INFERIOR ASPECT.

Gyri Occipito-temporales (Fig. 3).

The inferior aspect of the hemisphere for the distance

to which it extends behind the *Fossa Sylvii*, pertains partly to the *Lobus Occipitalis*, in part to the *Lobus Temporalis*, which lobes here pass into one another without

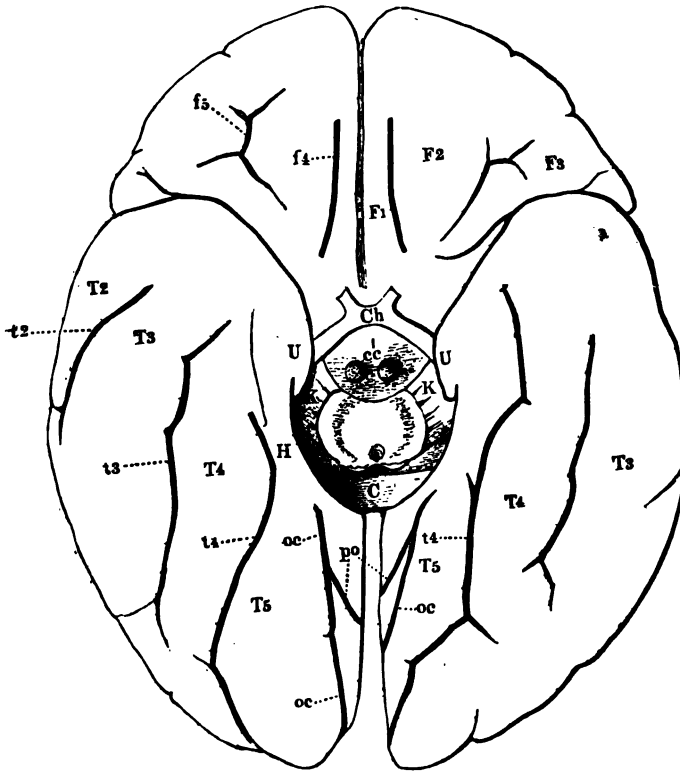


FIG. 3.—VIEW OF THE BRAIN FROM BELOW. F₁, Gyrus rectus. F, Middle, F₂, Inferior Frontal convolution. f₁, Sulcus olfactorius. f₂, Sulcus orbitalis. T₂, Second or Middle, T₃, Third or Inferior temporo-sphenoidal convolution. T₄, Gyrus occipito-temporalis lateralis (Lobulus fusiformis). T₅, Gyrus occipito-temporalis medialis (Lobulus lingualis). t₁, Sulcus occipito-temporalis inferior. t₂, Inferior, t₃, Middle temporo-sphenoidal Fissure. po, Parieto-occipital Fissure. oc, Calcarine Fissure. H, Gyrus hippocampi. U, Gyrus uncinatus. Ch, Optic Chiasma. cc, Corpora callosa. KK, Crura cerebri. C, Corpus callosum.

any distinct frontier-line intervening, and is in the district of the first-named lobe, for the extent to which it

rests upon the *Tentorium*, slightly concave, while in the district of the latter lobe—in the median cranial fossa—it is convex. Upon it there may be seen a deep and constant fissure, one already described above (p. 51) as the *Sulcus Occipito-temporalis*. By it two convolutions are divided off from one another—the *Gyri Occipito-temporales inferiores*, which may be thus distinguished.

Lobulus
lingualis.

4. *Gyrus Occipito-temporalis medialis*. Pansch. The Lingual Lobule (T_5).

Syn. Lobulus lingualis. Zungenläppchen. Huschke.
Untere innere Hinterhauptwindungsgruppe (No. 17). Bischoff.

This gyrus is bounded laterally by the *Sulcus Occipito-temporalis* (t_4) mentioned above, and mesially by the *Fissura calcarina* (oc), and has generally a club-shaped or laminar form. The narrow portion, or pedicle, ('Stiel') passes under the *Splenium corporis callosi* from the *Gyrus Hippocampi*, and from there the convolution broadens out behind, again to taper off, as a rule, quite posteriorly towards the top of the Occipital Lobe. This posteriorly narrow end of the gyrus is in relation with the extremity of the Occipital Lobe, and, to wit, mostly with the convolution described above (p. 46) as the *Gyrus descendens*, which, encircling the posterior ramus of the Calcarine Fissure loopwise, brings the convolutions of the upper aspect of the *Lobus Occipitalis* into relation with those situated upon its inferior surface.

Lobulus
fusiformis.

5. *Gyrus Occipito-temporalis lateralis* (Pansch).
'Spindelläppchen' (T_4).

Syn. Lobulus fusiformis. Spindelförmiges Läppchen. Huschke.
Unterer äusserer Hinterhauptwindungszug (No. 18). Bischoff.

This gyrus is always distinctly bounded mesially by the *Sulcus Occipito-temporalis inferior*, while laterally the third Temporo-sphenoidal fissure—*Sulcus Temporalis inferior*—forms the boundary against the inferior Temporo-sphenoidal convolution. Since, however, this fissure is frequently absent, or undeveloped, the lateral boundary of the convolution in question is consequently by no means always equally defined. The gyrus in question is of extremely variable shape, being, for the most part, broader in the middle, while in front and behind it tapers off somewhat, being in relation posteriorly as well with the above-mentioned gyrus as with the *Gyrus descendens*.

There are now five Temporo-sphenoidal gyri to which prominence has been given, but, as has been already mentioned, they are by no means all simultaneously or uniformly developed, so that in order to be correct it will be found very advisable—in accordance with Bischoff's proposition—to fix before the mind's eye those convolutions first which undergo the least variation, and then from these as a starting point to make search for the rest. Only the following, however, are constant—1. On the lateral upper aspect of the Temporo-sphenoidal Lobe, the *Gyrus Temporalis superior* sive *inframarginalis*, which appears almost always distinctly bounded by the Sylvian Fissure and the superior Temporo-sphenoidal sulcus. 2. On the inferior aspect, and at the mesial margin of the Temporo-sphenoidal Lobe, the Lingual Lobule and the *Gyrus Hippocampi* are invariably clearly to be distinguished, bounded mesially by the *Fissura Hippocampi* (*h*), and laterally by the *Fissura Temporo-occipitalis inferior*. As to what, however, lies between the last-named fissure on the one side and the *Fissura Temporalis superior*

on the other, this presents very varying degrees of development. At times there are two sulci to be distinguished in this space, lying more or less parallel to the foregoing, whereby consequently three gyri may be divided off, while at other times but one sulcus is distinguishable, and, as a consequence, only two convolutions.¹ There are, accordingly, distinguishable as well on the Occipital as on the Temporo-sphenoidal Lobe five convolutions which take a 'sagittal' course. Of these two—the *Gyri Occipito-temporales*—pertain to the two lobes in common, so that each of the lobes in question possesses but three gyri peculiar to itself which run in the direction indicated, and only one of these respectively, namely, the *Gyrus Occipitalis primus* and the *Gyrus Temporalis superior*, occupy an independent position, while the second and third convolutions of either group pass either directly or indirectly into one another.

E. Mesial surfaces of the Frontal, Parietal, and Occipital Lobes.

Now that the Frontal, Parietal, and Occipital Lobes have been severally considered, it becomes necessary to cast yet a glance at the mesial surface, the sulci and gyri upon which extend themselves equally over the greater part of the above-mentioned lobes, and must, on that account, be considered in common.

SULCI AND GYRI.

Sulcus
calloso-mar-
ginalis.

1. *Sulcus Calloso-marginalis*. The Calloso-marginal fissure. (cm) Huxley. Bischoff. Turner. Marshall.

¹ See especially on this point my illustrations of the brain of a fetus at the eighth and at the ninth month in the *Archiv für Anthropologie*, Bd. iii. Heft 3.

Syn. Grand sillon du lobe fronto-pariétal. Gratiolet.
Sulcus fronto-parietalis internus. Pansch.

This fissure is of so definite a shape, that it had been already clearly recognised and demonstrated at a period when but little attention was bestowed upon the convolutions in other ways—by Vicq d'Azyr, for instance. In the foetus it is already visible at a very early period.

The fissure takes its origin beneath the anterior extremity (genu) of the *Corpus callosum*, and passes, separated from this latter by the *Gyrus fornicatus* ('Zwingenwulst') around the genu in an outward direction, and runs posteriorly, about midway between the upper surface of the *Corpus callosum* and the superior margin of the hemisphere. At first it runs parallel to the surface just mentioned, but a short distance in front of the posterior end (*splenium*) of the *Corpus callosum* it turns outwards toward the upper mesial edge of the hemisphere, here to terminate. The notch in the mesial edge, by which it ends, is already recognisable in a view of the hemisphere from above, and will be found (*c m*, Fig. 2) immediately behind the mesial extremity of the posterior Central convolution. From the point at which the sulcus begins to take an outward direction, there often passes posteriorly, still following the original direction, a very slight extension of the fissure on to the quadrangular surface of the *Præcuneus*. Along the whole course of the sulcus smaller secondary fissures are given off, as well anteriorly into the *Gyrus fornicatus* as in an outward direction into the *Gyrus marginalis* ('Randwulst'). Not unfrequently the sulcus is bridged over here and there by gyri, which bring the convolutions, just described as separated by it, into relation with each other.

Gyrus
fornicatus.

2. *Gyrus fornicatus*. 'Bogenwulst,' Arnold (G f).

Syn. Processo enterideo cristato. Rolando (*loc. cit.* p. 33, Taf. ii. a).

Circonvolution de l'ourlet. Foville.

Zwinge, cingula, or gyrus cinguli. Burdach.

Callosal gyrus. Huxley.

Fornix periphericus, äusseres Gewölbe. Arnold.

By the above name the archlike convolution skirting the *Corpus callosum* has been designated, which begins under the anterior end, or *genu*, of the latter, in the form of a slender gyrus, and then strikes out round the *genu* to attain the upper surface of the *Corpus callosum*, and runs upon it posteriorly, adding by degrees to its bulk; and, on arriving at the posterior extremity of the *Corpus callosum*, turns downward around it (the *splenium*) to the Temporo-sphenoidal Lobe, upon the median edge of which it runs a further course as the *Gyrus hippocampi* (H). The slender convolution out of which the *Gyrus fornicatus* arises, begins under the top of the *genu* of the *Corpus callosum* and beneath the *Septum pellucidum*, and is here in relation with the *septum*, the median root of the Olfactory nerve, and the *Gyrus rectus*. Then the convolution, waxing broader as it runs forwards, divides into two portions, of which the more anterior ascends and unites itself with the median portion of the uppermost frontal gyrus (*pli de la zone externe*. Gratiolet), while the posterior is none other than the *Gyrus fornicatus*. Ere, however, it is prolonged into the *Gyrus Hippocampi* it enters into several other relations. First it rises posteriorly, and fuses with the *Præcuneus* (P_1'), the base of which rests upon it for the whole of its length; then, just behind the posterior extremity of the *Corpus callosum*, there passes out from the *Gyrus forni-*

catus a narrower gyrus (O'_s , Fig. 6), which, after that it has sunk down deep, enters into communication with the apex of the *cuneus* (O_s). This I shall call the *Gyrus*

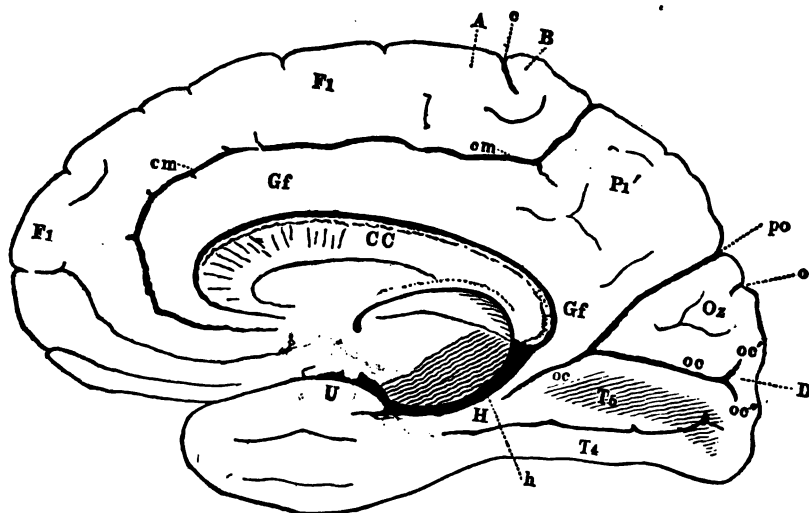


FIG. 4.—VIEW OF THE RIGHT HEMISPHERE ON THE MEDIAN ASPECT. CC Corpus callosum longitudinally divided. Gf. Gyrus fornicatus. H. Gyrus hippocampi. h. Sulcus hippocampi. U. Uncinate Gyrus. cm. Sulcus callosomarginalis. F, Median aspect of First Frontal Convolution. c. Terminal portion of the Sulcus centralis. A. Anterior, B. Posterior Central Convolution. P. Precuneus. O. Cuneus. po. Parieto-occipital fissure. o. Sulcus occipitalis transversus. oc. Calcarine fissure. oc' Superior, oc'' Inferior ramus of the same. D. Gyrus descendens. T. Gyrus occipito-temporalis lateralis (Lobulus fusiformis). T₄ Gyrus occipito-temporalis medialis (Lobulus lingualis).

cunei ('Zwickelwindung').¹ Finally the *Gyrus fornicatus*

¹ Bischoff (*loc. cit.* s. 47) calls this gyrus the inferior, or fifth parietal convolution (No. 15), and regards it rightly as the homologue of the inferior inner annectent gyrus of the ape brain. Gratiolet, as has been mentioned above, describes the inner (i.e. lying on the mesial aspect) 'bridging convolutions' which pass from the *Precuneus* into the *Cuneus*, and distinguishes them as the internal superior and internal inferior bridging convolutions respectively (*plis de passage internes, supérieures et inférieures*). With regard to the former, the superior internal annectent gyrus, I avail myself of this opportunity to express my opinion about it.

Bischoff (*loc. cit.* s. 79) holds the view that this convolution is homolo-

fuses with the anterior extremity of the Lingual Lobule, *Gyrus Occipito-temporalis medius*, and then pursues its further course as the *Gyrus hippocampi*. There pass then by degrees over into the *Gyrus hippocampi*: 1. The *Præcuneus*. 2. The *Cuneus*. 3. The Lingual Lobule. At the inferior and mesial edge—that which rests upon the *Corpus callosum*—of this convolution there is deve-

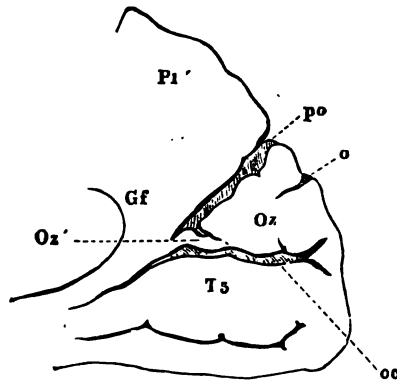


FIG. 6.—VIEW OF THE POSTERIOR EXTREMITY OF THE RIGHT HEMI-SPHERE, SEEN ON ITS MEDIAN SURFACE.—P'. Præcuneus. O. Cuneus. po. Parieto-occipital Fissure. o. Sulcus occipitalis transversus. Gf. Gyrus fornicatus. Oz' Convolution of the Cuneus. oc. Calcarine Fissure. T, Gyrus Occipito-temporalis medialis (Lobulus lingualis).

loped a layer of white medullary substance, which covers its grey cortex (*Stria longitudinalis sive tecta*), and

gous with the first external annectant gyrus of Gratiolet—my *gyrus occipitalis primus* O,—and is, consequently, absent when the latter is developed, and *vice versâ*. I regret that I must go counter to this opinion, for, not only are the two convolutions—as I shall explain more at length in another place—most distinctly developed side by side in the brains of various apes (*Cercopithecus*, *Cynocephalus*, &c.), but there will be found not unfrequently in man a convolution which takes origin, with the *Gyrus occipitalis primus*, at the posterior extremity of the *præcuneus*, and runs posteriorly in a curve, having its convexity mesially and downwardly directed, while the former, as is well known, presents a curve convex in a lateral direction. In the *cuneus* the two *gyri* then become fused together again. As a rule, this gyrus is deeply imbedded in the *Fissura parieto-occipitalis*, and can only be brought into view by the separation of the edges of this fissure, but at times it makes its way to the surface, and there then results a very unusual aspect of this part of the cerebral surface.

spreading itself out further backwards and downwards on the *Substantia alba reticularis*, covers the surface of the *Gyrus Hippocampi*.

3. *Gyrus Hippocampi*. Burdach (H).

Gyrus
hippocampi.

Syn. Subiculum cornu ammonis. Burdach.

Circonvolution à crochet. Vicq d'Azyr.

Pli unciforme, ou temporal moyen interne et lobule de l'hippocampe. Gratiolet.

Uncinate gyrus. Huxley.

This gyrus is situated at the inferior mesial edge of the Temporal Lobe, which girts the *Pedunculi cerebri*, being bounded laterally by the anterior portion of the *Fissura Occipito-temporalis inferior*, and mesially by the *Fissura Hippocampi*, and may be regarded as the common extension of the *Gyrus fornicatus*, of the *Gyrus Cunei*, and of the Lingual Lobule. After that the *Gyrus Hippocampi* has originated beneath the posterior extremity of the *Corpus callosum* out of the three factors just named, it pursues its course as far as the tip of the Temporo-sphenoidal Lobe, where it terminates with a crook-like curve—the *Uncus gyri fornicati*, or *Gyrus uncinatus* (U)—at the beginning of the transverse portion of the Sylvian Fossa behind the *Substantia perforata lateralis*.

Gyrus
uncinatus.

4. *Fissura Hippocampi* (h).

Fissura
hippocampi.

Syn. Anterior portion of Scissure de l'Hippocampe. Gratiolet.
Dentate sulcus. Huxley.

The inner surface of the cerebral ventricles is brought into immediate relation with the peripheral surface of the brain by a large cleft—the *Rima transversa cerebri* (Burdach)—which consists of a middle and two lateral portions.

The median portion of this cleft is extended transversely between the *splenium* ('Balkenwulst') and the *Corpora quadrigemina* ('Vierhügeln'), being bounded above by the former, and below by the latter and the Pineal gland ('Zirbel'), and leads into the third ventricle. The lateral portions extend from here in a curve outwards, inferiorly, and anteriorly at the inner side of the inferior lobe, between the inner part of the *Operculum* and the floor of the lesser cornu ('Unterhorn'), and pass into the *Cornu descendens*. This fissure is accordingly bounded laterally by the concave edge of the *Gyrus hippocampi*, and, if the edge be lifted somewhat, a sulcus comes into view which runs the length of this margin, and at the bottom of which a grey cord lies. This sulcus stands in a precisely similar relation to the *Cornu Ammonis* as the *Calcarine fissure* does to the *Calcar avis*. In other words, it pushes the wall of the posterior cornu inwards before it in the direction of the ventricle, thus causing the above-mentioned projection upon the floor of the cornu. On this account the fissure has been termed the *sulcus*, or *Fissura Hippocampi*.

*Gyrus
dentatus.*

5. *Gyrus dentatus* sive *Fascia dentata*.

Syn. Dentate gyrus. Huxley.

Corps godronné. Gratiolet and others.

The *Cornu Ammonis* presents a convolution which is made to project upon the cavity of the posterior cornu. If the convolutions in general have upon transverse section, as Meynert has correctly remarked, the shape of a U, that is, of the letter reversed—thus $\cap$ —the vault of which looks toward the surface, as the sulci do that of an

erect U, in like manner there projects here such an U of the latter kind—a prominence of *repoussée* work as it were¹—into the cavity of the posterior cornu, which thus constitutes the prominence of the *Cornu Ammonis*. The concavity of the U, however, is not left empty, but is, for the most part, filled in with grey matter, and most internally with a continuation of the *Substantia alba reticularis*. At the very top lies an intricately knotted cord of grey matter—the *Fascia dentata* or the *Gyrus dentatus*. This small grey gyrus begins behind the *Splenium corporis callosi*, upon the mesial surface of the *Gyrus fornicatus*, or the *Fasciola cinerea*, then it descends, covered by the *Fimbria* or *Tænia*, down to the *Cornu Ammonis*, and terminates, finally, as the so-called *Cauda*, upon the inferior surface of the *Fasciculus uncinatus* ('Haken').

Scarcely in any other particular does the brain of the majority of apes differ so essentially from that of man as in regard to the above-mentioned *Fissura Hippocampi*. In man the *Gyrus fornicatus* passes, as we have already seen, without break into the *Gyrus Hippocampi*, and it consequently results from this continuation of the convolutionary track that the *Fissura calcarina* and *Fissura Hippocampi* are separated off from each other. In the apes, on the other hand—as is so well known, with the exception of *Ateles* and *Hylobates*—the two fissures just mentioned pass into one another without a break, and it is thus that the *Gyrus fornicatus* and *Gyrus Hippocampi*

¹ 'gleichsam von getriebener Arbeit.'

come in their case to be parted from one another. Thus it is that even Gratiolet—who derived his terminology entirely from the simian cerebrum—has described the two fissures which we distinguish respectively as *Fissura calcarina* and *Fissura Hippocampi*, as but a single one—the *Scissure de l'Hippocampe*.

F. The Island of Reil. 'Insellappen,' 'Insel' (Reil).

Syn. Stammlappen. Lobus caudicia. Burdach.

Zwischenlappen, or Versteckter Lappen. Lobus intermedius sive opertus. Arnold.

This lobe lies concealed between the Frontal, Parietal, and Temporo-sphenoidal Lobes, being overhung in particular by the *Operculum*, so that it is only brought to light by drawing aside the margin of the Sylvian Fissure, and is girt by a channel. Its surface presents to view certain short convolutions (*Gyri breves*, Gall) which radiate anteriorly, upward, and posteriorly from a central spot on the inferior surface, and have a slightly curved hook-like appearance.

APPENDIX.

As a corollary to the conviction expressed in the Preface, namely, that it was the duty of the physician to supply the material for a future organography of the cortex of the cerebrum, I think it may be worth while to add a few remarks upon the methods of examination and the proper registration of observations.

In order to find one's way aright amid the seeming chaos of convolutions, the best course to pursue will be to make the primary sulci one's starting point. After that, then, the *Pia mater* has been cleared away as much as possible from the brain,¹ on its removal from the cranial cavity, the *Fissura Sylvii* (S) must first be sought for, together with its two rami, the posterior horizontal (S') and the anterior ascending (S'') ramus. Taking next the *Operculum* ('Klappdeckel'), which intrudes itself between these two rami, as a starting point, search must be made for the *Sulcus centralis* (c) and the two Central convolutions—the anterior (A) and posterior (B)—which form its boundaries. Starting from the anterior one (A), the Frontal convolutions (F₁, F₂, F₃) must next be followed out, the most inferior of which (F₃) encircles in a loop the anterior ascending ramus of the *Fossa Sylvii* (S''). Upon that part of the surface of the brain which is situated behind the central sulcus—Parietal and Occipital Lobes

¹ This clearance can best be made under water, but it will not do to keep the brain immersed too long, otherwise it will be rendered too soft by absorption of water.

—the *Fissura Parieto-occipitalis* (*po*), which notches into it from its mesial margin, and which, especially if one starts from the mesial surface, is easily discoverable, forming as it does on the said surface the anterior boundary of the easily recognisable *Cuneus* (O_2), and dividing off the Parietal from the Occipital Lobe. The lateral extremity of the sulcus in question is encircled by a loop-like convolution, to which I have given the name *Gyrus Occipitalis primus* (O_1). If now the fissure (*ip*) which forms the lateral boundary of this convolution be followed forwards, it will be found—of course making allowance for an occasional interruption by bridging gyri—to run laterally and anteriorly, and divide the Parietal Lobe into two halves. This fissure is the *Sulcus interparietalis*, and the two divisions of the Parietal Lobe which it marks off are the upper (P_1) and the lower (P_2) Parietal Lobules respectively. The latter consists of an anterior cluster of convolutions (*Gyrus supramarginalis*, P_2), which passes in a curve around the upper end of the Sylvian Fissure into the uppermost Temporo-sphenoidal Convolution, and of a posterior group (*Gyrus angularis*, P_2'), which passes into the second Temporo-sphenoidal Convolution, embracing the uppermost Temporal Fissure (*t'*) in its loop. Upon the Temporo-sphenoidal Lobe, which underlies the horizontal ramus of the Sylvian Fissure, the upper Temporo-sphenoidal gyrus (T_1) and sulcus (t_1) will be respectively recognised with ease. And in regard to the remaining portions, as well of the Temporo-sphenoidal as of the Occipital Lobes, I would refer the student to the description already given of them above. If a median section be made through the *Corpus callosum*, &c., whereby the two halves of the cerebrum are separated, one will then be enabled to view the sulci and gyri of the median and inferior surfaces in their relation to one another. First one follows the *Gyrus fornicatus* (*Gf*), which, after making the complete circuit of the *Corpus callosum*, is then directly prolonged into the *Gyrus Hippocampi* (*H*), and finishes up with the *Gyrus uncinatus* ('Hakenwindung' *U*) at the anterior, inferior, and median end of the Temporo-sphenoidal Lobe. There are in relation with this *Gyrus fornicatus*—1. The *Præcuneus* (P_1'). 2. The *Cuneus* (O_2); and—3. The Lingual Lobule (T_5).

The great difficulties attending accurate description would

seem to render it advisable always to make a sketch of that portion of the brain-surface upon which convolutions having an abnormal arrangement have been met with. For this purpose geometrical drawings taken with the Diopter of Luce¹ are to be above all others preferred, as well for their correctness as for the ease with which they may be made; for the action of which instrument I would refer in particular to the paper by Landzert² in the *Archiv für Anthropologie* (Bd. ii. s. 1).

For the preservation of brains in case that either a more minute examination cannot be made straight off after the autopsy, or it is desired to retain the specimen altogether as a preparation, the chloride of zinc solution proposed by Gratiolet and Bischoff³ is to be recommended above all other media, in that it is not necessary to clean off the *Pia mater* from the brain previous to placing the latter in the fluid, as the membrane, after it has been soaking for a time, becomes more readily removable than it would from a brain which is quite fresh. If, however, spirit of wine be used for hardening the brain tissue, previous removal of the *Pia mater* becomes absolutely necessary, which can easily be done under water, if the brain be placed immediately afterwards in absolute alcohol. Even brains that have been hardened in chloride of zinc must, after some time, be placed in spirit of wine. For the complete preservation of the shape of the brain, an injection also of spirit of wine or of chloride of zinc into the carotids is much to be commended, though, after the employment of the first-named liquid, the future study of the convolutions may be attended with difficulties on account of the close adherence

¹ Rudolph Wagner, however, in his *Vorstudien* (Göttingen, 1862, 2te Abhand. s. 6), recommends, from his experience, neither this process nor that of photography. Transl.

² The title of Dr. Theodor Landzert's paper is 'Welche Art bildlicher Darstellung braucht der Naturforscher?' Transl.

³ *Abhand. der k. bair. Akad. der Wissen.* Cl. ii. Bd. x. s. 401. The strength of the solution is unfortunately not stated. It is recommended that the brain be kept for not too long a time in the chloride of zinc solution, as, because the latter has always an acid action, it brings about, sooner or later, a softening of the albuminous material of the brain. This, however, can be counteracted by placing the brain in spirit of wine, the strength of which must not be excessive. Transl.

of the *Pia mater*. I will only mention, in conclusion, that Dr. A. Ziegler, of Freiburg, has undertaken to construct a wax-model of the convolutions of the human brain, after designs furnished by me, which will very shortly be obtainable from him.

At Professor Ecker's particular desire, I append here Dr. Ziegler's (of Freiburg, in Baden) prospectus of the wax models which he has prepared to illustrate both this work and Professor Ecker's paper in the third volume of the *Archiv für Anthropologie*, to which allusion has already been made in the Preface. Transl.

SERIES I.

(In illustration of the paper in the *Archiv für Anthropologie*), comprising 14 models.

1. The brain of a fœtus at the 12th week, *loc. cit.* Taf. I., figs. 1, 2, 3, 5.
2. A longitudinal section of the same. Left half. *Ibid.*, fig. 3.
3. The brain of a fœtus at the 4th month (16 weeks), *loc. cit.* Taf. I., figs. 6, 7.
4. A longitudinal section of the same. Left half. *Ibid.*, fig. 8.
5. A brain of a fœtus at the 5th month (19 weeks), *loc. cit.* Taf. I., figs. 10, 11, 12.
6. A longitudinal section of the same. Left side. *Ibid.*, fig. 13.
7. A brain of a fœtus at the 6th month (23 weeks), *loc. cit.* Taf. II., figs. 1, 2, 3.
8. The same in longitudinal section. Left half. *Ibid.*, fig. 4.
9. The brain of a fœtus at the 7th month (28 weeks), *loc. cit.* Taf. II., figs. 6, 7.
10. The same in longitudinal section. Left half.
11. The brain of a fœtus at the 8th month (32 weeks), *loc. cit.* Taf. III., figs. 1, 2, 4, 6.
12. A longitudinal section of the same. Left half. *Ibid.*, fig. 5.
13. The brain of a fœtus at the 9th month (36 weeks), *loc. cit.* Taf. IV., figs. 1—4.
14. The same in longitudinal section. Left half.

SERIES II.

(In illustration of the present work.)

1. The cerebrum of an adult.
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